Features of Electrical Operation in a Large Industrial Plant,—Graphical Methods for the Calculation of Busbar Sizes

Electrical World

DEC 30 1916

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SIMPLICITY HONESTY

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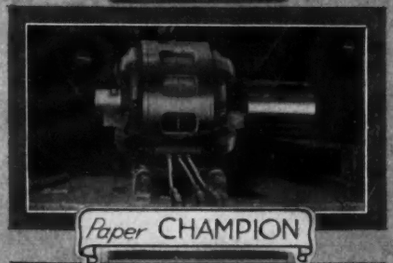
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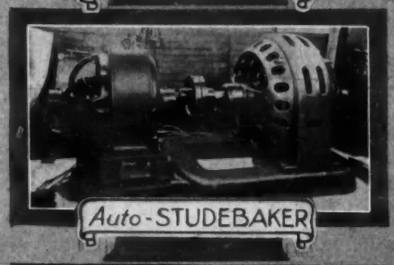
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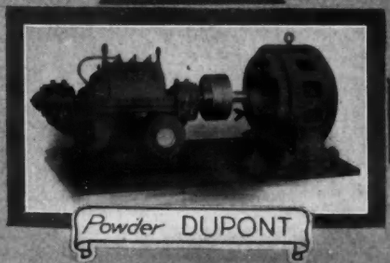
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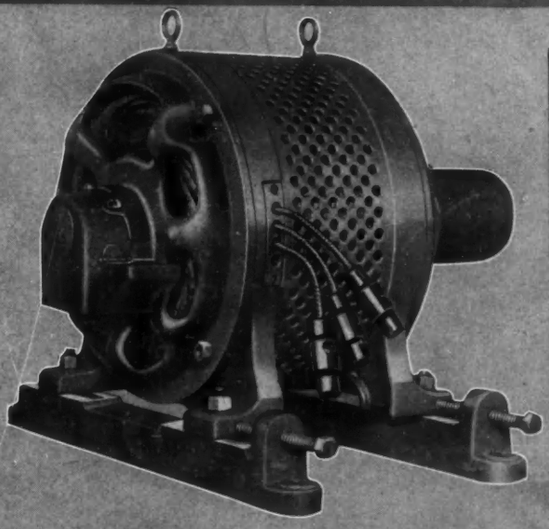

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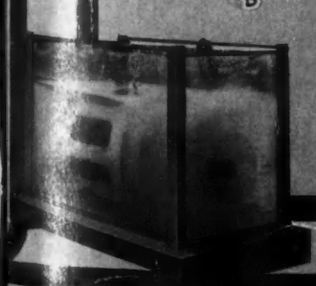

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Turn of the Year

THE passing of the trying year 1916 arouses conflicting feelings. Never has the electrical industry been so prosperous outwardly, never have conditions of operation been so difficult. Business in plenty, but the means to do it all inadequate. Orders in floods, but raw materials scarce and labor independent or tyrannical. Volume of gross business in every department of electrical activity is at the high tide as the year closes, but the problem of deciding upon future policies was never more difficult. The manufacturer, who begins the work which the distributers complete, faces the possibilities of radical revision in raw material prices. Yet even if he is convinced that declining demand will cause lower prices his output is sold far ahead and he cannot afford not to protect himself with reasonable supplies of those materials which he knows will be required. The largest distributing interest, the central station, is operating at or near capacity and a breathing spell would give the needed opportunity for new construction work, some of which has been postponed by unsatisfactory conditions affecting building and labor. Normally the electrical industry is one of steady growth, it is not a "prince or pauper" industry, and it has abiding confidence in the strength of the future.

Efficient Steam Station Design

ECONOMIC features of interest to the designer are outlined in an article of this issue which discusses the layout of the new steam station of the Ohio State Power Company recently completed at Fremont, Ohio. This station will help out an adjoining hydroelectric plant on the Sandusky River, which has been a victim of hydraulic errors in judgment, such as sometimes happen, by which it failed to deliver the minimum power for which contracts had been made. Lack of sufficient data as to variations of flow or hard luck in the way of exceptionally dry seasons produce this unhappy result now and then and the remedy was wisely sought in the present steam station. The layout deserves attention, for it is unusually compact and built on the unit system so that each 24 ft. in length gives a unit complete with all its auxiliaries and its boiler plant. Everything is simply arranged on a single level with accessibility in mind and only the high-tension oil switches and similar apparatus are carried above the immediate floor level. Each turbine is supplied by a pair of boilers, whose stacks are of reinforced concrete mounted on steel supports directly above the boilers giving a short and straight path for the flue passes without sacrificing space in the boiler room. In point of fact this particular arrangement proved to be cheaper both in first cost and operating expense than the more usual layout. The boilers which are built for 250 lb. pressure and 125 deg. superheat, are fed by automatic stokers themselves supplied by a monorail coal handling plant. In the turbine room all the auxiliaries are stowed away in the space under each unit. The electrical part of each turbo generator is of the customary three-phase, 60-cycle form arranged as a 4000-volt, four-wire, system with grounded neutral, a very convenient arrangement for the distributing voltage. The switchboard like the plant in general is provided with a section for each unit and the buses are of copper tubing, with spacers every 4 ft. to prevent distortion in case of short-circuits. Advantage is taken of the four-wire connection to use the 4000-volt distribution for the neighboring system and incidentally there is a step-up system for supplying power to neighboring distribution covering longer distances. A plant of this kind is simple both in construction and operation and is a capital example of the unit plan of design so convenient both in working a station and providing for its extension when necessary.

Brooklyn Rate Decision Modified

IT costs something to compromise, but if the cost amounts to less than the expense of contest the net result is gain. Evidently this thought was in the mind of the New York Public Service Commission of the First District when it compromised the rate case of the Edison Electric Illuminating Company of Brooklyn. The modified rate schedule which the company has promptly agreed to put in force represents a substantial modification from the terms of the first order. Behind this settlement is a strong array of logical reasons to justify it. There is a lesson for both regulating bodies and public utilities in the fact that in taking this action the commission directs attention to important considerations which just now affect central stations so seriously. These are, in brief, increases in costs of every character, the uncertainties produced by war and, in addition in the case of the Brooklyn company, reduced rates for city lighting. The structure of conditions upon which the commission based its original decision disappears under the stress of an unprecedented situation. Results are not the same in normal peace times and in a period of world-wide conflict, hence the treatment of the question of rates cannot be expected to be the same. The commission wisely decided to recognize the growth of new and far-reaching influences, unforeseen when its case was started.

Our Turn to Be Regulated

PUBLISHERS of national periodicals have lately felt the hand of federal regulation. We have had occasion before this to call attention to what we believed was the shortsightedness of regulatory bodies with relation to the activities of the central station, the manufacturing and the trade branches of our industry. The ELECTRICAL WORLD has also had opinions of its own when the work of such bodies seemed fair and just. A rider on the post-office appropriation bill, known as the Randall rider, now puts the ELECTRICAL WORLD in the position of its readers and gives them the opportunity to judge in their turn of the fairness of a law restricting the work of our journal.

Briefly, a rider has been drafted dividing the United States into zones. Instead of postage on publications of national circulation being 1 cent per pound, it would be, should this measure be enacted into law, 1 cent per pound up to 300 miles; 2 cents for 300 to 600 miles; 3 cents for 600 to 1000 miles; 4 cents for 1000 to 1400 miles; 5 cents for 1400 to 1800 miles, and 6 cents over 1800 miles.

This increase in postal rates obviously burdens the publisher immediately. Just as obviously, however, he must pass the increased cost sooner or later along to the reader, and in fairness he must add to his subscription rate the added cost of transportation in proportion to the added cost of the zone system.

The final result of the bill, in other words, affects the reader more than the publisher, and the proposed idea, striking as it does at the periodicals of national circulation, we oppose on broader grounds than first or second costs to us. If there ever was a time when this country needed national unifying influences it is here now. Our publication stands or falls on its educational value and its actual performance of a service to our readers, linking together the activities of the industry from Maine to California. We want to continue to render that service to our readers at the lowest cost to them. In common with other industries our costs have advanced. We have met these extra costs just as our readers have met theirs in many cases by increased organization effort.

The national publications, next to the schools and colleges, are the greatest educational force in this country. The Randall rider, if passed, will interfere seriously with the widest distribution of intimate technical and business information in all lines. It seems unfortunate, to quote but one example, that while the Federal Trade Commission urges a better understanding of business through the mediums of the trade and technical press, that the post-office branch of the government proposes to handicap the very work of government. It seems unfortunate that the work of other constructive departments like the Bureau of Agriculture and the Department of Commerce should each be attempting to carry out a broad plan of national education almost unaided except for the business press, while another branch of the government puts a brake on the strongest influence in the national training of our industries.

If you as a reader believe in extending the service of this journal and of other journals which seriously feel their responsibilities as mediums for the expression of thought and opinion in their respective industries, we urge that you write to your congressman and express your disapproval of the ill-considered Randall rider.

The Handwriting on the Wall

A FEW weeks ago the State Public Utilities Commission of Illinois handed down its decision in the case of the Lincoln Water & Light Company. In disallowing an increase in the modest yearly fee paid the holding company the commission had occasion to say something on holding companies in general, and in particular on the one involved in the case at bar. It would not deny compensation to a holding company for services actually rendered in the interests of the community; but, it said, "it is nevertheless a fundamental fact that the organization of the holding company is primarily for the protection of the financial interests involved—to render more secure the holding company's investments, to enhance the earnings of the subsidiaries for the benefit of the holding company, and to investigate and report upon, not only the existing subsidiaries, but also contemplated new subsidiaries, all for the ultimate benefit of the holding company. The public of a city served by a subsidiary is not particularly benefited, either directly or indirectly, by several of the holding company's expenditures, and, in general, there can be no logical reason for apportioning all of a typical holding company's expenses among the constituents." These are not weasel words. The commission was of the opinion that the managerial and office salaries, coupled with the allowance to the holding company, would ordinarily be quite adequate to provide for an excellent and full local organization in Lincoln were the company severed from its parent. While the $2,000 fee paid to the holding company was regarded as compensation for operating services only, the commission said it was quite fair and adequate, particularly in view of the record, which disclosed that the company's operation and management are not so superior to the average run of isolated independent utilities as to warrant large service fees to the holding company.

Now comes the Board of Gas & Electric Light Commissioners of the Commonwealth of Massachusetts, seasoned and conservative in all its actions and forthwith orders that hereafter no company under its supervision shall enter into contracts and relationships with engineering, construction and managerial organizations and corporations save under exceptional circumstances and these to be determined by the commission. This order raises the question whether syndicated absentee landlordism is better than home rule for public utilities. It is designed to prevent profits on management, engineering and purchase of supplies through contracts negotiated by the same interests sitting at both sides of the table at the expense of the consumer. Surely the Massachusetts commission must have had great provocation to issue such an edict. The organizations or cor-

porations against whom it is directed have evidently left undone the things which they ought to have done and done the things which they ought not to have done, so that there is no health in them. Without withholding regular dividends to stockholders they have thrived on extra benefits from administrative and related services. Where such profits are made by the managing interests the operating cost is often excessive. It is not to be inferred that all companies engaged in this class of work are guilty of the practices complained of; but evidently the general situation was such as to cause the commission to view it with concern. While its order attacks ingrowing managerial profits it leaves the door open for companies to demonstrate the desirability of centralized management in specific cases. It is good, however, that the issue has been raised. The system which has in recent years grown up in the management and operation of utilities is capable of much good and not a little evil. If practice has shown that the bad features predominate, then the sooner it is wiped out the better it will be for the industry.

The actual, physical connection of a number of contiguous properties into one and their operation as a single system, if properly and efficiently done, benefits the company and the public alike. This no one will deny. But a union of non-continuous properties under a single management not absolutely and directly responsible to any one local public is often of dubious advantage save to the bankers. The findings of the Illinois and Massachusetts commissions are merely corroborative of a condition which has been known to exist for some time in the general utility field. Investigation will show that those syndicated railway, gas and electric properties which are continuously in hot water with the public they serve, which do not give the service they should, and which are in more or less of a crippled condition are for the most part in the hands of financiers rather than operators. In the electric utility field the most successful companies are those locally managed, whose guiding spirits are local men who know the local situation and take pride in making their institution an honor rather than a byword to the community. Practice and experience have shown the futility of rubber stamps as managers. The indications are that the axe is gradually being applied to the root of the syndicate trees; every tree therefore which does not bring forth good fruit will be hewn down and cast into the fire.

The Fine Art of Applying Electric Power

IN an early issue of this year the main features of the carefully worked out motor installations in the new Chicago plant of the Crane company were outlined. The further details of this important installation which appear in this number show the degree to which automatic operation has been carried in a distribution system that covers more than forty-five acres, furnishes power to 10,000 hp. in motors and is supervised by a force of only six men. Such a result can only be reached by a very far-seeing grasp of the manufacturing as well as the purely electrical requirements. It demands centralizing the supervision of the equipment, providing automatic operation to the utmost limit possible and taking every conceivable precaution for continuity of service. The power supply is from the great Chicago central station system inasmuch as the Crane company wisely decided that its proper work is specialization in operation rather than in power production. The feeders to each motor run in separate conduits, the transformer equipment is in duplicate banks so that failure in one will not shut down any part of the plant. All fuses are omitted and only substation circuit breakers employed so that the operative need not worry about his power supply and can devote his whole attention to the work in hand. Everything is done throughout to relieve the workmen from any consideration of the electrical part of his equipment. He simply goes about his business and leaves the rest to the central station and the switchboard force. The completeness of the electrical drive has been fairly equalled in the plant processes. Everything which can be done electrically is so done, from running intricate machines to collecting dust, separating brass and iron filings by a magnetic separator and delivering raw material by electric power. So thoroughly has the plant been worked out to avoid interruptions that even in the electric plating department duplicate motor generators have been installed so that by no chance can anything happen to interrupt the steady flow of product through the factory. In fact, nothing has been omitted to make the power supply universal and remove it from the serious thought of the workmen who are engaged in manufacturing. Since a holdup anywhere in the line of progress may mean a costly delay, the extreme care that has here been taken to avoid any such difficulty is a most meritorious example of efficiency in production.

The Coming Annual Review Issue

IN the next issue of the ELECTRICAL WORLD many branches of activity within the industry will be treated in special articles. The definite purpose of this issue is to give not merely a review of performances during 1916, but to interpret the bearing of these conditions upon 1917; in short, to discuss tendencies which appear to be clearly forecast. It is not by loose prophecy but by wise consideration of the past and conservative but confident planning for the veiled future that the industry will progress. Among those who will assist the readers of the ELECTRICAL WORLD in looking ahead to the business probabilities of the new year are Thomas A. Edison, H. W. Buck, H. A. Wagner, Peter Junkersfeld, Robley S. Stearnes, Dr. W. R. Whitney, Halford Erickson, W. L. R. Emmet, Albert Lincoln Salt, Edward N. Hurley, T. C. Martin, Dr. E. F. Roeber, Dr. A. E. Kennelly, Dr. W. F. Durand, P. S. Millar, Arthur Williams, J. L. Hogan, Jr., Dr. Louis Bell and B. A. Behrend.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

COMMONWEALTH EDISON NEW OUTPUT RECORD

Company Delivers 5,176,527 Kw.-hr. to Distribution System on Same Day That Peak Load Reaches Record of 369,740 Kw.

On Dec. 19 the Commonwealth Edison Company of Chicago delivered to its distribution system 5,176,527 kw.-hr. This is the first time in the history of the company that the output in any twenty-four-hour period has passed the 5,000,000 mark. The peak load on the company's stations occasioned by this enormous demand for electrical energy was 369,740 kw., which is also the greatest peak the company has ever experienced. It is an unusual occurrence for the annual peak and the maximum yearly output to fall on the same day, as they have this year. In 1915 the peak for the year reached 337,900 kw. on Nov. 29, 1915. The maximum twenty-four-hour output last year was 4,550,137 kw.-hr. on Dec. 29.

Of course, it is possible that even the record set on Dec. 19, 1916, may not stand as the maximum for 1916. The company's yearly peaks for several years have been definitely attributable to its electric railway load, the peak always occurring on a cold day when the greatest number of car heaters was in use at their maximum rating. This year's experience has proved no exception to that rule.

INTERLOCKING MANAGEMENTS TABOOED BY COMMISSION

Massachusetts Commission Disapproves Overlapping Control in Construction and Managing Contracts and Will Have No More of It

In an order recently made public, the Massachusetts Gas & Electric Light Commission sets forth its disapproval of certain classes of public utility construction and management contracts in which overlapping control is a feature of the administration. The order, which is addressed to all companies under the commission's direction, states that the board has for some time viewed with concern the control of the directorates of certain of the companies under its supervision by officials and employees of engineering construction and management organizations and corporations with which the companies involved have from time to time contracted for extensions and improvements of and managerial services for their respective properties. In the opinion of the commission such practices are wrong in principle.

The order states that whatever justification may exist for these practices in public service companies whose credit is feeble or future hazardous and uncertain, "that justification ceases when their financial position is firmly established. The management of such companies should be in the hands of directors and officers responsible solely to their stockholders and the public whom they have undertaken to serve. For reasons that are obvious companies should not have any dealings in supplies or materials or make any contracts for construction or management with another corporation, partnership or association when said company has upon its board of directors or as its president, manager, purchasing or selling officers, or as its agent in the particular transaction, a person who is at the same time a director, purchasing or selling officer, or agent of, or who has any substantial interest in, such other corporation, partnership or association, unless and except such purchases shall be made from, or such dealing shall be with, the bidder whose bid is the most favorable to such company, to be ascertained by honestly conducted competitive bidding. Notice is hereby given of the conclusions reached by the board to the end that no company under its supervision shall hereafter enter into contracts and relationships of the character above described save under exceptional circumstances and with the approval of the board, and that upon the expiration of existing contracts they shall not be renewed."

PORTLAND, ORE., PAVES WAY FOR MUNICIPAL PLANT

City Council Adopts Recommendations of Commissioner of Public Utilities That Street Lighting Contract Be Let for Only Two Years

By adopting recommendations of Will H. Daly, commissioner of public utilities, that a contract be made between the city and the Portland Railway, Light & Power Company for lighting the city streets and buildings for two years, the City Council indirectly gave its approval of a plan for the establishment of a municipal lighting plant for Portland. Heretofore, the contract for street lighting has been let for a longer period. The lighting company submitted a lower figure for lighting the city during a five-year period than in a two-year period, but rather than tie the city up in a contract which would necessarily forestall the establishment of a municipal plant for at least five years, Commissioner Daly recommended that the contract be made for only two years.

Commissioner Daly outlined his proposed plan for a municipal lighting plant and system, based on extensive investigations which have been made by engineers of the water bureau during the past two years. He said it was conceded it would be an economic advantage to the city to construct a generating plant and install its own lighting system, because within a few years it will be necessary for the city to construct impounding dams in the Bull Run watershed for the storage of water during the winter season to supply the needs during the summer, and as large amounts of power may be developed from the fall of water through this dam he believes it should be utilized.

In making his deductions, he said the city is spending annually about $200,000 for energy for lighting of streets and public buildings; also that there are on file more than 1200 applications for additional lights, many of which should be installed, but cannot be on account of lack of funds. He further stated that there are hundreds of post lights throughout the business districts which are illuminated at the expense of the property owners and business men which should be maintained at the expense of the general public. Commissioner

Daly stated that a distribution system equal to the one owned and operated by the Portland Railway, Light & Power Company could be installed at a cost of $800,000. A detailed report will be submitted by the commissioner on the project about Feb. 1, and he will then recommend that the Council submit to the voters a proposal to bond the city for the amount required for the development of the project.

NORTH AMERICAN MISSOURI PROPERTIES CONSOLIDATE

Plans Announced Whereby Union Electric Light & Power Company Is to Absorb the Electric Company of Missouri

Plans for the absorption of the Electric Company of Missouri by the Union Electric Light & Power Company of St. Louis were announced on Dec. 19 by Charles S. Ruffner, vice-president and general manager of the Union Electric Light & Power Company. Both properties are controlled by the North American Company.

In announcing the plan Mr. Ruffner stated that the consolidation is designed to eliminate unnecessary overhead expense, saying that "naturally, with the overhead cut down it will be possible for the company to continue its policy of reducing rates as consumption increases unless increased price of materials or other unexpected developments should make such a reduction impossible." The Missouri Public Service Commission will be asked to ratify the plan some time in January, according to present arrangements.

The Electric Company of Missouri is capitalized at $2,000,000 stock and $1,750,000 bonds and has about 10,000 customers. The Union Electric Light & Power Company is capitalized at $9,885,000 stock and $17,071,000 bonds.

BROOKLYN RATE ORDER MODIFIED BY COMMISSION

Public Service Commission Amends Its Requirements and Company Accepts the New Schedule to Go Into Effect Jan. 1

As a result of further investigation, the New York Public Service Commission of the First District has amended its order in the rate case of the Edison Electric Illuminating Company of Brooklyn, making changes which have a substantial effect. On Dec. 27 the company announced that it would accept the order as changed, so that new rates will go into effect on Jan. 1.

The final order of the commission provides that the new rates shall be 8 cents per kilowatt-hour for the first two hours' average daily use of the maximum demand, 6 cents for the second two hours' average daily use of the maximum demand, and 5 cents for the excess over four hours' average daily use of the maximum demand. The maximum demand, except when determined by meter, shall be calculated as not in excess of 50 per cent of the consumers' connected load in the case of residence customers, not in excess of 70 per cent of the connected load for other lighting consumers, and not in excess of 80 per cent for power consumers, provided, however, that the maximum demand shall not in any case be assumed to be less than 1.5 kw.

Commissioner Haywood, who wrote the supplemental opinion in the case, says that the officers of the company asked that consideration be given to developments since the record was closed which gravely affected the company's business, such as the great increase in the cost of coal and the general rise in the price of all materials and supplies, the increase in the rates of wages accomplished by a reduction in hours of labor, greatly increased tax assessments, the reduction in the rates for city lighting, and the uncertainties introduced in the situation by business stimulated by the war, the continuance of which could not at the present time be counted on.

It was urged, said Commissioner Haywood, that the company is under the necessity of making extensive capital expenditures in order to provide adequate service, and to invest large sums which will not bring immediately to the company a fair return on the outlay. The officers of the company expressed the apprehension that it would prove difficult in view of the valuation found and the drastic reductions in the rates orders to enlist capital for necessary additions. Investors giving attention only to the figure of the final valuation of $22,000,000 would not appreciate the fact that according to the commission's own determination the property of the company represented outlays of approximately $30,000,000, and that though $7,000,000 was deducted for depreciation on account of lack of newness, property to this amount was still in existence and in the service of the consumer.

Commissioner Haywood added: "With reference to the schedules ordered, it was urged that these should conform more closely to the present practices of the company, with which its customers were familiar. The company's representatives stated that certain features of the present schedule, with reference to the rating of installations, while perhaps discriminatory in form, were not discriminatory in purpose, and did not impose an unjust burden on the small consumer, if account is taken of the relative larger cost per kilowatt-hour involved in serving the smaller consumer. Any change in the fundamental features of the schedule introduces uncertainty in the calculations as to the effect of the new rates, and would seriously interfere, if not render it impossible, to put reduced rates into effect without considerable delay.

"The company placed itself on record as willing to discontinue the general practice of issuing Gem lamps to consumers and to substitute the 50-watt Mazda lamp as the standard and to charge for lamps on the basis of cost, either in a fixed price per lamp or in a kilowatt-hour charge in connection with the service.

"In regard to the power schedule, the company's officers expressed their willingness to abolish the discounts as required by the commission, but proposed that in view of the low average rate now charged for current for power purposes, the rates for the primary and secondary steps be applied to one hour's daily use of the maximum demand, or thirty hours per month, instead of twenty-five as at present. In order to obviate criticism, they further suggested that, except where determined by meter, the maximum demand should be assumed to be not more than 80 per cent of the connected load for all installations under 10 hp. in place of the present schedule of 85 per cent, where one motor is used and 75 per cent where more than one motor is used. It is intended as soon as practicable to place maximum demand meters on large power installations.

"With reference to the wholesale contracts, the company submits that in view of the importance of these contracts and the large amount of revenue involved under each one of them, it is impossible to make a revision of these rates in accordance with the commission's recommendations in thirty days, and that six months should be allowed for a thorough study.

"The representatives of the company urge that the present form of its lighting rate schedules should be retained because its customers are now familiar with it, and that a radical departure from it would add mate-

rially to the cost of inspection of consumers' installations in the case of the great army of small customers, and would make it impractical to put into effect new rates without delay. The present practice of rating all installations at a minimum demand of 1.5 kw. has the effect of applying the maximum rate to customers using 90 kw.-hr. or less. This it contends is not unfair. Certain consumer costs are approximately the same for all customers, regardless of the amount of current used. Such expenses, sometimes spoken of as 'consumer costs,' form, however, relatively a greater part of the cost of serving comparatively small customers than of larger consumers, and therefore justify a higher rate per kilowatt-hour for smaller consumers, a result which is indirectly brought about by the present practice of the company.

"The company further submits that the adoption of a new percentage rating for demand renders uncertain the final effects of any rates ordered. It holds that the present practice is satisfactory to its customers, and that any one aggrieved may, on payment of $1 per month, have the maximum demand definitely ascertained by meter.

"The commission does not believe the present system of computing maximum demand on the basis of percentages of connected load to be satisfactory. The cost of ascertaining demand by meter is, however, prohibitive in the case of the great mass of consumers. In order to avoid delay in putting the new rates into effect, it would seem expedient to continue its present system and to adjust new rates thereto."

COMPETITIVE ASPECT OF LARGE POWER SALES

Large Industrial Corporations Have Knowledge of Cost of Power in Different Cities in the Country And Expect to Secure Best Rates

The sale of power by central stations on a large scale is often if not always an acutely competitive undertaking. President Cabot of the Turners Falls (Mass.) Power & Electric Company remarked upon this at a recent hearing before the Massachusetts Gas and Electric Light Commission, saying: "The sale of large power is one of the most competitive businesses there is. The Fiske Rubber Company of Chicopee, Mass., knows as much as I do about what other people are paying for power in Detroit, Washington, Fall River, etc. We are competing with everybody in the business whose business is subject to public regulation. It is perhaps one of the most important advantages of public regulation that enables the customer to find out what the other fellow's price is and make us toe the mark."

In view of this situation, which is by no means appreciated by the general public, it is easy to see wherein the modern sales manager has his work cut out for him. To successfully approach a large power prospect it is by no means sufficient to prepare oneself simply upon the prevailing rate schedule of the local system, but it is necessary to know and to be able to explain if necessary the fundamental differences in conditions that justify differences in rates among various localities. National manufacturers often purchase energy in widely separated states and differences in rates as well as in bills are almost inevitable. What the public does not realize is that the power company is "up against" the keenest kind of competition in the shape of comparisons of its rates and contract arrangements with other companies hundreds or thousands of miles away. When the question of isolated plant versus purchased energy has been worked out for such a prospective customer, the battle is only half won, and this branch of central station practice may well be dignified by being classed as professional engineering service.

FEDERAL COURT UPHOLDS MASSACHUSETTS COMMISSION

Stock Exchange Ticker Service Held to Be Intrastate When Quotations Are Distributed to Customers of Telegraph Company

Judge Dodge, of the United States District Court, at Boston, handed down an opinion Dec. 20 upholding the finding of the Massachusetts Public Service Commission in the Foster stock ticker case, and affirmed the previous decision of the Massachusetts Supreme Court. Foster petitioned the commission to order the Western Union Telegraph Company to furnish him with ticker service at Boston, and the company refused to do this on the ground that the failure of the New York Consolidated Stock Exchange to approve Foster's application made it impossible to furnish the service under the terms of the existing contract between the Exchange and the Western Union company. After protracted hearing, the Public Service Commission declared in favor of Foster, setting forth that he was being discriminated against by the company and that the business of distributing the quotations to customers of the telegraph company is intrastate. The Supreme Court of Massachusetts upheld this view. On the bill filed in the Federal Court, Judge Dodge declares that the New York Stock Exchange cannot claim to be delivering its quotations through the service of a common carrier of its own selection, to persons in Massachusetts selected by it, at prices fixed by it, and that the Interstate Commerce Acts do not apply to the distribution of the quotations by the telegraph company, although those acts govern the transmission from the Exchange in New York to the telegraph company in Boston.

PROGRESS ON MILWAUKEE STREET LIGHTING SYSTEM

Contracts Let for Approximately $440,000 Worth of Material — Some Above and Some Below Engineer's Estimate—Work to Be Rushed

F. A. Vaughn, consulting engineer for the Bureau of Illumination Service for the city of Milwaukee, Wis., has issued a report covering the activities of the bureau from July to December, 1916, inclusive. In this report he outlined the organization installed to carry out the city's lighting work and reviewed interesting features of purchases of material. Concerning the latter he said in part:

"Specifications for wires and cables were issued, and contracts let in the fall for this material amounting to $190,354. (See ELECTRICAL WORLD, Sept. 2, 1916.) These contracts were awarded to: American Steel & Wire Company, Boggis-Dietz Electric Company, representing the Simplex Wire & Cable Company, Hazard Manufacturing Company, Julius Andrae & Sons Company, representing the Safety Insulated Wire & Cable Company. Under these contracts about 75 per cent of the total cable required for the system was purchased, and while the price was high compared to the anticipated price, a purchase of this amount of cable at that time has since been thoroughly justified. The cable is of a new electrolysis-protected type, which has never been manufactured in this country before, but which at

least one of the cable manufacturers claims he intends to make standard in the future. A perusal of the proposals at that time indicated that it might be possible to purchase an additional 200,000 ft. of cable at a very reasonable price from one of the contractors, and, therefore, an additional specification was issued for 200,000 ft. more of cable, with the result that this additional amount was secured at a very low price under the circumstances. This additional amount was secured for $33,000.

"Specifications for refracting glassware were issued on Aug. 4, and a contract for this material amounting to $22,860 was awarded to the Line Material Company. The prices secured on this material were considerably below the engineer's estimates of cost, and the total saving on this item amounted to approximately $7,140. The large refractor was estimated to cost $8 and the actual cost was $5.96, and the small refractor was estimated to cost $3, whereas the actual cost was $2.49. The city is in a position, under its form of contract, to take advantage of these prices in the purchase of more of these goods at the same prices.

"Specifications were issued for concrete posts and brackets on Aug. 7, and after controversy over the lowest competent bidder new specifications were issued on Sept. 6, and a contract for this material amounting to $114,075 was awarded to the Universal Concrete Products Company. The prices secured on these posts are not directly comparable with the engineer's estimates because of changes in the artistic design recommended by the committee of architects, members of the Milwaukee Art Society and others. The increase in price was due somewhat to this change.

"Specifications were issued for harp castings on Sept. 16, and contracts for this material amounting to $12,780 were awarded to the Julius Andrae & Sons Company and the Central Foundry Company. The saving over the engineer's estimate on this contract was approximately $1,500.

"Specifications were issued for transformers on Sept. 11, and a contract for this material amounting to $35,306.72 was awarded to the Kuhlman Electric Company. The saving over the original estimate in this case is probably due to (*a*) change of design, making it easier and cheaper to manufacture the transformers and improving certain design features, and (*b*) the size of the order.

"Specifications were issued for street lighting fixtures on Nov. 22, and a contract for this material amounting to $44,907 was awarded to the Line Material Company. The saving over the engineer's estimate on these fixtures and that on the refracting glassware which goes with them amounts to nearly $30,000, which will pay for the increased price of approximately 460,000 ft. of high-voltage, steel-taped, underground cable used for this system.

"Approximately 2000 nitrogen-filled incandescent street lamps were ordered from the Westinghouse Lamp Company. By ordering these lamps on the city's present lamp contract, the discount on all the lamps purchased by the city under its blanket contract was increased from 29 per cent to 33 per cent. A saving of 4 per cent on every lamp purchased was thus effected.

"With reference to deliveries on the above contracted-for material, it can be reported that all manufacturers of cable have made deliveries, and cable to the extent of several carloads has arrived or is en route, practically 200,000 ft. being en route at the present time. A quantity of refractors has also been received, and the total quantity contracted for will have left the factory before the first of the year. Samples of the new transformer have been received and placed under thorough inspection and test by the bureau and certain improvements in design have been required which may temporarily delay the delivery of this material, to the ultimate advantage of the city. Shipments of the harp castings and of the incandescent lamps have also been received. The street lighting lanterns are now being manufactured and will be delivered on time. The other smaller pieces of apparatus and material have been ordered or will be ordered before the last of the current year.

"By the first of the year approximately 65 per cent of the material for the entire recommended installation will have been contracted for. Sufficient funds will have been reserved to begin installation of the system as soon as the weather permits in the early spring.

"While some of the materials, especially those involving the use of copper and other high-priced metals, have exceeded the engineer's estimates, quite a number of contracts were, in spite of the present prevailing high prices, let at figures below the engineer's estimates. This tends very largely to counteract the increases. Just how much one will counterbalance the other cannot be accurately determined until all material has been purchased and the installation contract let, but it is believed that the excess over the engineer's estimates will be very small."

COMMISSION ACTS TO END COAL CAR SHORTAGE

Illinois Railroad Companies Ordered to Return All Coal Cars Received in Intrastate Commerce to Owners as Soon as Empty

The inability of the railroads to furnish sufficient cars to move the existing volume of coal business appears to be the root of the present coal shortage, which is now giving many public utility enterprises no little concern. In the State of Illinois it became apparent that unless some relief was afforded, numerous isolated electric utilities would be forced to cease operations due to their inability to secure coal. To prevent such a possibility and to relieve the general coal shortage which is prevalent over the entire State, the Public Utilities Commission of Illinois has issued to all railroads operating within the State of Illinois, general orders 32 and 34, which tend to facilitate the movement of coal cars and thereby to reduce coal shortage.

General order 32, issued Nov. 29, 1916, requires all railroad companies operating within the State of Illinois to promptly return all coal cars received in intrastate commerce to their owners, after such cars have been unloaded and made empty, unless it should happen that such cars can be immediately loaded for return to the owner.

General order 34, issued Dec. 4, 1916, provides that all railroad companies operating within the State of Illinois are authorized to put into effect, on one day's notice, a change in Rule 7 of Demurrage Tariffs now on file with the Commission, which shall apply only to intrastate shipments of coal and coke in Illinois. The change thus authorized provides for a demurrage charge of $1 for the first day after the expiration of the free time allowed for unloading, $2 per car for the second day, $3 per car for the third day, $5 per car for the fourth day and every succeeding day. Authority is also given to publish such changes, in other demurrage rules, as are provided for in the order issued by the Interstate Commerce Commission in connection with the I. & S. Docket No. 966. General order 34 further provides that the changes authorized in the demurrage rules filed in compliance with the order, shall remain in effect until May 1, 1917.

SECRETARY LANE SUGGESTS WATER POWER COMMISSION

Body to Have Power to Grant Leases for All Uses of Public Lands and Navigable Streams for the Development of Power

Secretary Lane has submitted to President Wilson for his approval and as a solution of the many conflicting water-power bills the draft of a proposed act establishing a water-power commission composed of the Secretary of War, the Secretary of the Interior and the Secretary of Agriculture.

This commission, under the terms of Secretary Lane's bill, would have the power to grant leases for the use of all public lands, including reservations, and navigable streams for the development of water power, under terms and conditions made by the commission. No lease would be made by the commission for more than fifty years.

Mr. Lane says that the advantages of this bill would be that the Administration would be held responsible for terms and conditions. The terms and conditions would be known and fixed in advance, and there would be no danger that the caprice of a cabinet officer would control the leasing.

BILL INTRODUCED TO REGULATE RADIO SERVICE

Government Seeks to Purchase Commercial Coast Stations and to Utilize Naval Stations for Business Communications

Senator Fletcher on Dec. 19 introduced in the Senate a bill to regulate radio communications. The measure was referred to the Committee on Commerce of the Senate. It is, in effect, based upon that act passed by Congress in 1912, which, Senator Fletcher explained, has served its purpose admirably, but experience gained since then has shown the necessity of strengthening some of its provisions. The bill that he introduced would change the existing act in the following important provisions:

1. All Government stations, mainly naval stations not reserved for Government business exclusively, may be opened to commercial business.

2. The bill enables the Government to purchase such commercial coast stations communicating with ships at sea, as the companies operating them are willing to sell at a fair valuation. The purpose is ultimately to establish the complete and exclusive Government system of commercial radio communications between the coast of the United States and outlying possessions and ships at sea. The need of such Government ownership and operation in time of war has been shown by the events of the past two years, but there is strong need for relief from the mutual interference between stations, with resulting reduction in the amount of business that can be handled adequately through the use of wireless telegraphy in a given area.

3. It provides that not to exceed one-third of the stock of corporations operating stations in the United States may be owned by aliens, and not more than one-third of the board of directors of these operating corporations may be aliens.

4. All licensed operators hereafter, except those serving on board ship, must be American citizens.

Mr. Fletcher explained that this bill was drafted by a committee representing all the departments of the Government. The same bill was introduced in the House by Representative Adamson, chairman of the House Committee on Interstate and Foreign Commerce.

INDICATIONS POINT TO RATE WAR IN LOS ANGELES

No Action Taken by Commission on Pacific Power & Light Competition Rate Filed in November

The city of Los Angeles has begun the extension of its distributing system into territory served by the Los Angeles Gas & Electric system and indications point toward a rate war. It has been stated by city officials that steps will soon be taken to begin proceedings to condemn for purchase by the municipality the desired portions of this company's electric distributing system.

In the meantime the contract for the sale of the systems of the other two companies, the Southern California Edison Company and the Pacific Light & Power Corporation, is being drawn up. This must be ratified by the stockholders of the two companies, and an amendment to the charter of the city must be passed by vote of the people and later approved by the State Legislature. After these matters have been completed, a bond issue for probably $12,000,000 will be placed before the voters for ratification. The city already has outstanding $10,000,000 indebtedness for power construction and distribution.

An injunction has been filed to prevent the "unfair, injurious, inequitable and illegal" action of the city of Los Angeles in buying power from Pasadena and distributing it in Los Angeles. The complaint declares the entire deal to be illegal and in direct violation of not only the California State constitution, but also of the Pasadena municipal ordinances. In citing the law, the complaint points out the specific citation that prohibits one municipality from selling electric energy for light and power to another municipality and at wholesale rates.

Thus far, however, this has not prevented steady progress on the city's extensions of service supplied with current by Pasadena. Mayor Woodman of Los Angeles has stated that after the operation of the two companies' systems has been taken over the city will be able to reduce the rate for household lighting from 5.5 to 4.75 cents per kilowatt-hour.

The attention of the ELECTRICAL WORLD has been called to the article on page 1041 of the Nov. 25 issue where it is stated that the Railroad Commission granted the Pacific Light & Power Corporation a special permit to invade competitive territory and meet the city's proposed reduced rates. As a matter of fact it is stated that no such permission was granted but that the rate was filed in the customary manner. The ELECTRICAL WORLD is informed that when the railroad commission act went into effect all the operating companies in the State were required to file a schedule of their rates. This they have done and from time to time have filed changes and amendments, the Railroad Commission contenting itself with accepting such rates and placing them in its files. The Railroad Commission continues to follow this procedure until a complaint is made either by some interested parties or started by the commission on its own initiative, whereupon after a hearing and the necessary investigation rates are fixed by the commission. No proceedings, it is stated, have as yet been started in either San Francisco or Los Angeles.

In regard to the reduction of the rate in the territory affected in Los Angeles the ELECTRICAL WORLD is informed that it has been the custom of the Railroad Commission where changes or alterations in rates have been filed, and where such rates are not increases, to accept them and file them, taking no action unless a protest is made in the matter.

Steam Station of Ohio State Power Company

Features of Unit Layout and Installation of Equipment in 15,000-kw. Steam Station at Fremont, Ohio, Which Wholesales Energy to Other Utilities

A NEW 15,000-kw. steam station has recently been completed by the Ohio State Power Company on the Sandusky River at Fremont, Ohio, which together with an adjoining water power station furnishes energy in bulk to the Ohio Light & Power Company and the Lake Shore Electric Railway Company. The sister station, a 3000-kw., 25-cycle, hydroelectric plant, was built in 1913 by the Sandusky River Power Company to supply the Lake Shore Electric Railway Company a certain minimum amount of energy each month under a contract carrying a penalty clause for failure to supply this minimum. The river did not deliver as much power as anticipated, and at the end of the year the penalties imposed were such that the Sandusky River Power Company actually owed its customer money. The Ohio State Power Company then took over the property of the Sandusky River Power Company and secured a 17,000,000 kw.-hr. a year minimum contract with the Lake Shore Electric Railway Company and an 8,000,000 kw.-hr. a year minimum contract with the Ohio Light & Power Company. The construction of a modern steam plant was planned large enough to carry the load and supply all energy required over and above the amount the hydraulic plant would develop. The new plant was designed as a 60-cycle station and new 60-cycle generators decided on for the water power station.

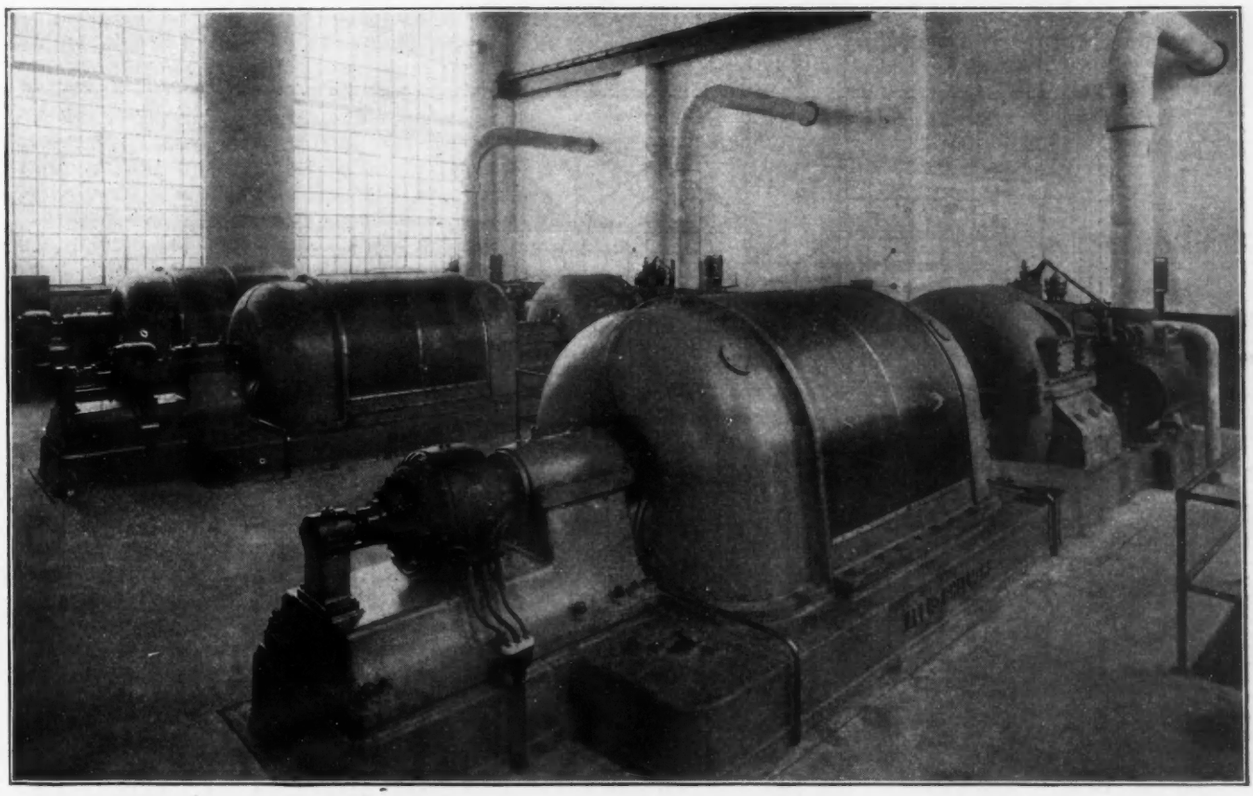


FIG. 1—TURBO-GENERATORS RATED AT 6250 KVA. IN FREMONT (OHIO) STATION, OF OHIO STATE POWER COMPANY

General Plan of Layout

The entire station is laid out so that a section through every 24 ft. of its length represents a generating plant complete in itself, with all its auxiliaries and battery of boilers. The arrangement provides for three 6250 kva. units and two batteries of two 750-hp. boilers each. This sectionalizing of the station layout reduces the matter of future expansion to the addition of another 24-ft. section on both the turbine and boiler rooms for the installation of another complete unit. The layout may perhaps be characterized as a one-floor level station, as the boiler room, turbine room and switchboard room are all on the same level with only the high-tension switching and protecting apparatus above this level. The only electrical equipment below this is the 4000/66,000-volt water-cooled transformers and station power and lighting transformers. The switchboard with all control circuits leading from it and the 4000-volt oil switches are on this main floor at the most convenient location for observation and immediate accessibility below this switchboard section of the station and the high-tension oil switches, lightning arresters, etc., directly above, as shown in an accompanying illustration.

Boiler Room and Coal Handling

The boilers are installed on both sides of a central firing aisle, opposite units forming a battery of two for each turbine. Each pair of boilers on the same side of the aisle is connected to the same stack. The stacks are constructed of reinforced concrete and mounted on steel supports above the boilers. This arrangement was adopted on account of the possibility it offered of placing the stacks most advantageously with reference

to the path of the gases directly into the bottom of the stacks, without sacrificing considerable space in the boiler room. While a heavier steel structure was required for this plan, a saving in first cost and operating expense was shown over the usual scheme of building the stacks from the ground up and enlarging the boiler room to provide the necessary additional space, or overplacing the stacks behind the boiler room and installing the long breeching. The plan makes a very compact boiler plant and has necessitated a minimum property purchase for the ultimate plant. The stacks are 104 ft. high above the steel supports and have an internal diameter at the bottom of 10 ft. 4 in., which tapers to 8 ft. 6 in. at the top. Babcock & Wilcox boilers are installed rated at 750 hp. each, and operated at 250 lb. pressure with 125 deg. superheat, each unit having 7629 sq. ft. of heating surface. The boilers are equipped with especially designed stokers built by the Jones Underfeed Stoker Company with four retorts for each furnace, the latter being 16 ft. wide. The boilers can be operated considerably above rated capacity.

The coal-handling equipment comprises a Pawling & Harnischfeger monorail system extending out from the boiler-room firing aisle on steel structures over a concrete storage pit. Coal is taken in the 1.5-ton bucket hoist directly from the cars or from the storage pit, carried over the monorail and dumped in the overhead bunkers in the boiler room, and from there is spouted to the various stoker hoppers. The ashes are dropped into hoppers beneath the furnaces and drawn into 27 cu. ft. capacity cars which run on an industrial track in the basement and dump into the ash storage bin just outside the plant. They are transferred from here to the coal cars by means of the monorail bucket hoist.

Turbine Room and Auxiliary Equipment

The use of combination condensate, air and circulating pumps in one unit made possible the complete installation of the turbine auxiliaries within the space available under each turbo-generator unit. Separate exciter units on the turbine-room floor have been avoided by the independent operation of the direct-connected exciters. Further to safeguard operation, an Illinois Engineering Company's automatic stop valve is placed in the steam main just above the throttle and so arranged that if the vacuum on the condenser is lost

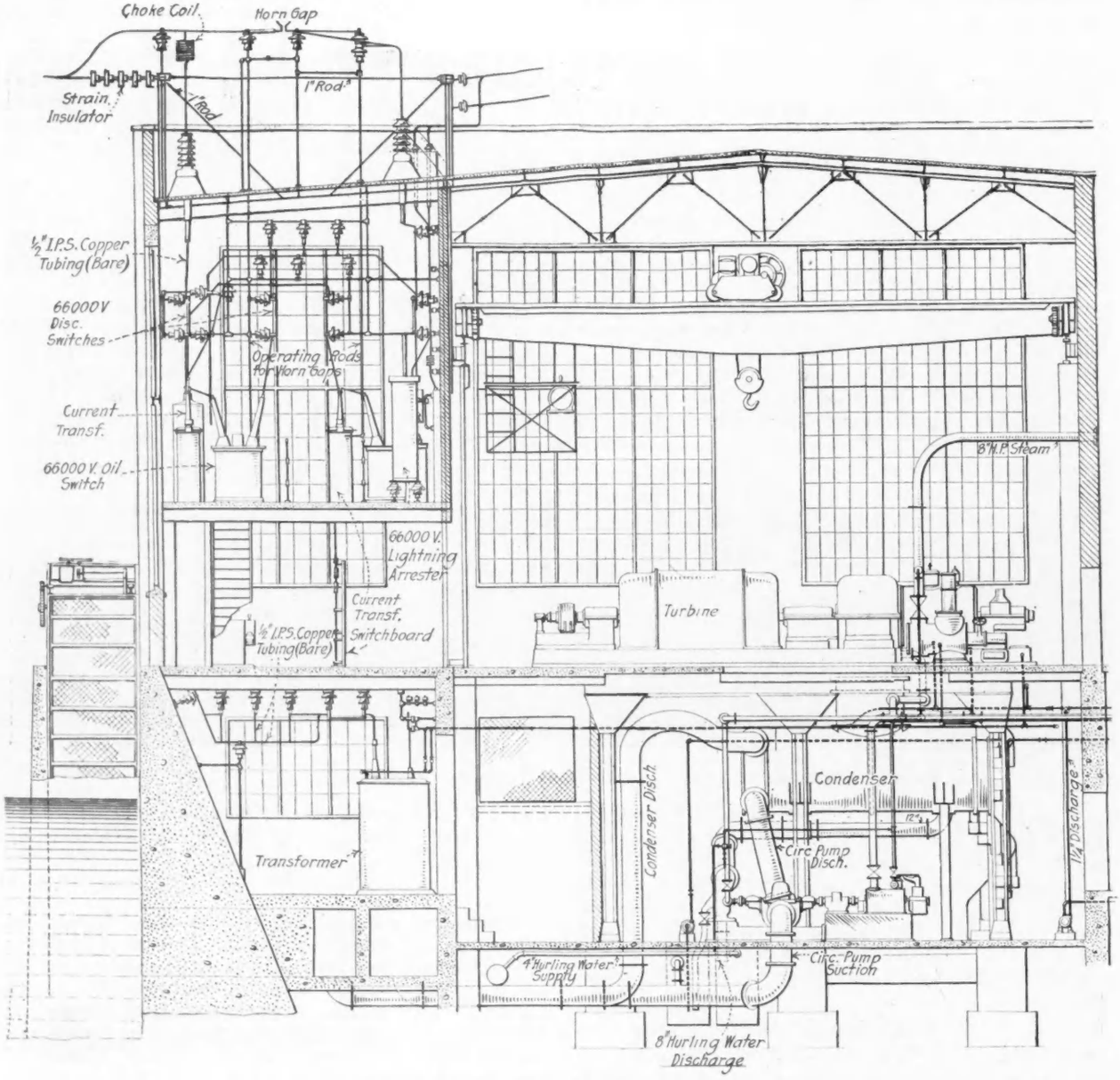


FIG. 2—SECTION THROUGH TURBINE ROOM AND HIGH-TENSION SWITCHING SECTION OF FREMONT STATION

for any reason this valve cuts off the steam supply and automatically shuts down the turbine. The generating units are 6250-kva., 3600-r.p.m., three-phase, 60-cycle, 4000-volt, four-wire grounded neutral Allis-Chalmers turbo-generators with the individual exciters mounted on the generator shaft. They are set across the turbine

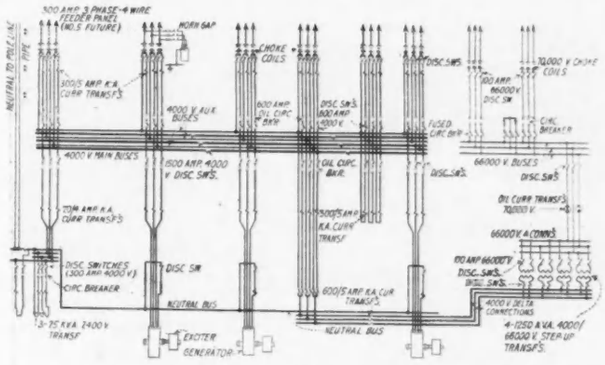


FIG. 3—LAYOUT OF CIRCUITS IN FREMONT STATION

room and served by a 25-ton, three-motor traveling crane.

The unit idea of the power-house layout was also followed in the selection and installation of the auxiliary equipment. A boiler feed pump and Hoppes feed-water heater are furnished for each of the two batteries of boilers, and a Clarage Fan Company's forced-draft fan for each boiler. A house-service pump, condenser and condenser auxiliaries, etc., are installed for each turbine. The combined condensate, air and circulating pump units are turbine driven and also the boiler feed pump. These turbines are identical in speed and size, but equipped with different ratio reduction gears to serve their respective requirements. The house pumps and soft and raw water pumps, however, are motor driven. One Bartlett & Graves water softener and purifier plant is located in the basement under the boiler room. In the raw-water intake a Chain Belt Company's traveling screen is installed which travels at normal speed of 4½ ft. a minute. Means are provided, however, for increasing this to approximately 9 ft. a minute.

The steam supply lines for the turbines driving the condenser auxiliaries are tapped into the main supply to their respective turbines just above the throttle. There is also a steam connection between the feed-water heaters and the turbines, so that in case the pressure in the heaters builds up, due to badly fluctuating load or any cause, a regulating valve opens and this pressure is taken back into the low pressure stages of the turbine and utilized.

The condenser water is taken from the bottom of the tunnel under the transformer room and drawn through 18-in. lap-welded pipe to the condenser and discharged directly back into the discharge tunnel in a circuit which is short and direct. The condensers and auxiliary pumps were furnished by the Wheeler Condenser & Engineering Company.

ELECTRICAL CONNECTIONS

The main bus in the station is divided by disconnecting switches into three sections so that any unit may be operated independently of the others if desired. In addition to this main bus, there is an auxiliary bus and also an auxiliary feeder to make possible the interconnection of the system in various ways. If it is necessary to work on the switches or instruments of any particular feeder in the 4000-volt local distribution system, this feeder can be energized from the auxiliary bus through the auxiliary feeder. The latter is equipped with an oil switch and disconnecting switches and complete instrument equipment with capacity large enough to take care of any two outgoing feeders. The bus arrangement also makes possible the supply of energy to any feeder from any generator and the paralleling or isolation of any generator. A small oil switch is provided in the neutral of each generator so that the neutral energy may be supplied from any other generator.

All the buses and heavy power leads are of copper tubing mounted on post-type busbar supports, and with busbar spacers placed about every 4 ft. to prevent displacement or distortion of buses due to the magnetic stresses under short circuit. The sixteen oil-switch compartments are constructed of 4-in. concrete with transite board partitions 1 in. thick. These oil-switch cells serve the purpose also of providing a fireproof

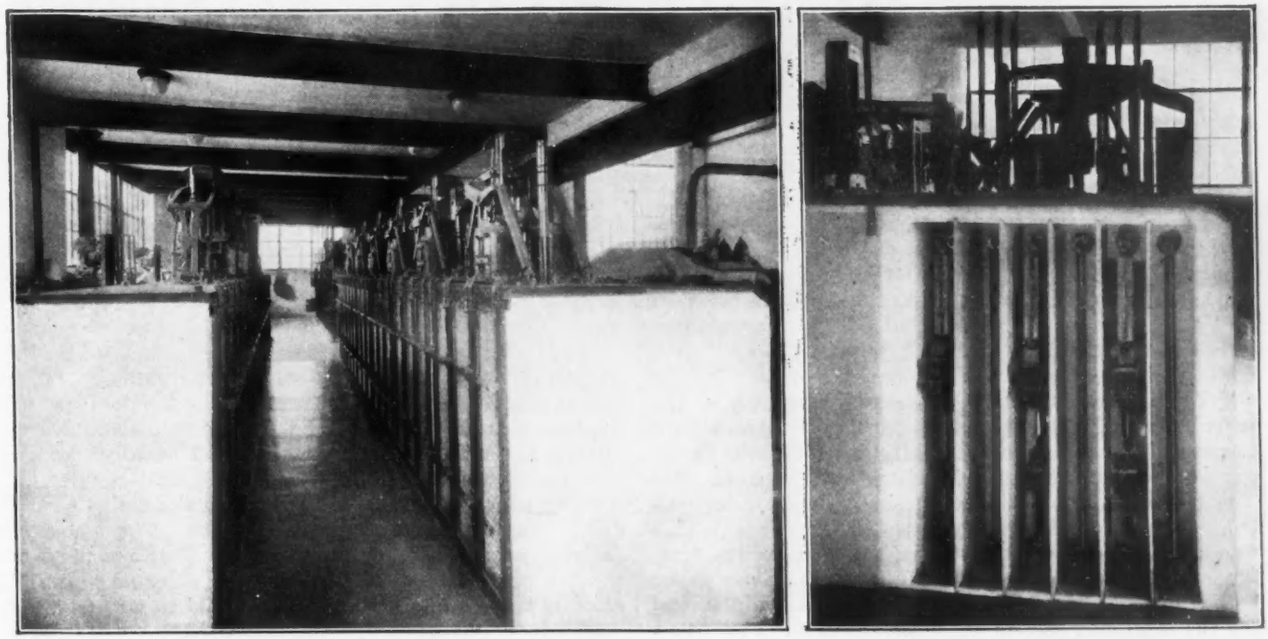
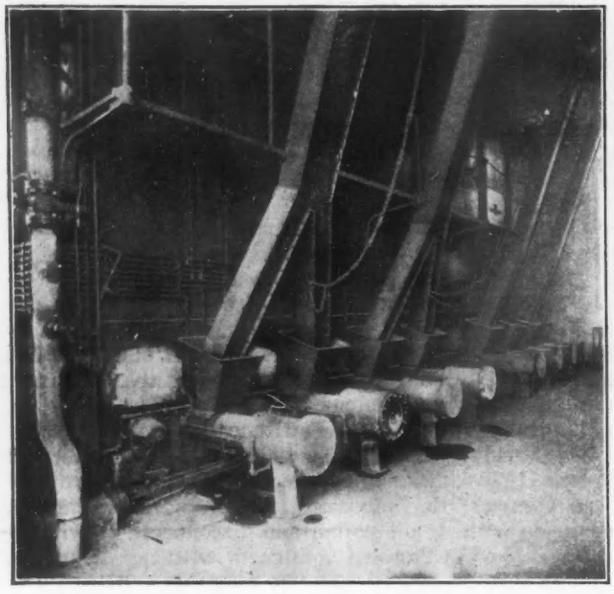
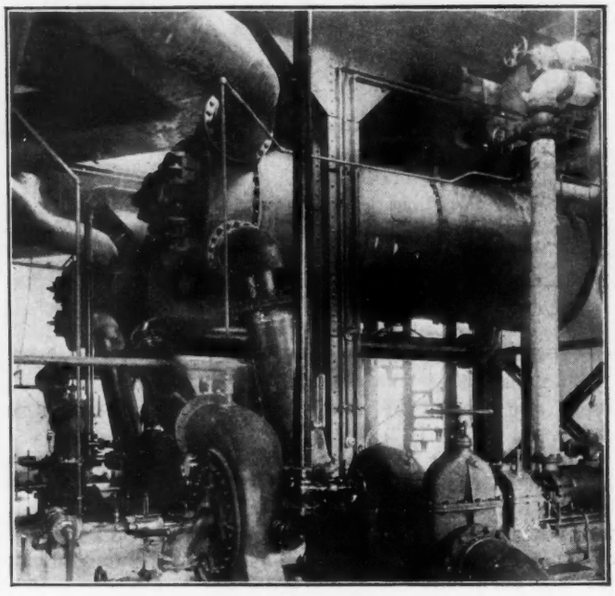


FIG. 4—OIL SWITCHES ON TURBINE ROOM FLOOR LEVEL AND COMPARTMENT FOR CURRENT AND POTENTIAL TRANSFORMERS

compartment for the potential and current transformers, which are mounted in the same compartment with their respective oil-switch poles. The advantages claimed for this layout are as follows: The whole unit —oil switch, disconnecting switch and current and potential transformers—is placed altogether to make a handy and accessible arrangement. Less space is required and the installation cost is reduced. Type C-1 Westinghouse oil switches are used in this connection, and lend themselves well to this compact construction. The busbar supports, disconnecting switches and the like were furnished by the Electrical Engineers Equipment Company.





FIGS. 5 AND 6—UNDERFEED STOKERS AND CONDENSER AND AUXILIARIES FOR ONE TURBINE UNIT

The outgoing lines at present include three 4000-volt, 300 to 500-amp. feeders for the Fremont distribution system, and one 4000-volt, 500-amp. tie feeder for the exchange of energy between the hydroelectric plant and the steam plant. There is also a connection from the 4000-volt bus and auxiliary bus, through a bank of four 4000/66,000-volt transformers which supply two outgoing high-tension feeders delivering energy to the distribution system of the Ohio Light and Power Company serving Fostoria, Tiffin, etc. These four water-cooled, 1250-kva., single-phase transformers are so connected that the spare unit can be switched in place of any other without disturbing any permanent connections.

The switchboard controlling these various feeders consists of twelve panels of black natural slate and one swinging bracket. The meters are the 7-in. Westinghouse dead-beat type. The watt-hour meters are mounted on the back of the board 5 ft. above the floor so that a man does not have to stoop to read them. The board is also equipped with a curve drawing voltmeter and a curve-drawing frequency meter. There is one Tirrill regulator panel, three generator panels, two two-circuit, 66,000-volt feeder panels, one two-circuit transformer panel, three two-circuit, 4000-volt feeder panels, one auxiliaries panel and one station panel. The Tirrill regulator is designed for individual exciter control, as the exciters are not operated in parallel. This was a matter of completely isolating each exciter from the others to avoid the possibility of shutdown when both units are operated in parallel and to avoid throwing the total load on any one when the other fails. This necessitated the installation of a complete spare unit so that the present peak load on the station can be carried by two of the three main units.

Energy for the remote control switching system is supplied by a battery of fifty-five E-9 cells furnished by the Electric Storage Battery Company. These are charged by a 2-kw. motor-generator set which is kept floating on the line with the rate of charging adjusted to be practically equal to the energy consumption of the indicating lamps on the switchboard.

This station was designed and the general construction contract was handled by Woodmansee & Davidson, consulting engineers of Chicago.

Compound for Use in Rebuilding Dry Batteries

The war in Europe has caused a scarcity of various articles once available in large quantities, and much effort and ingenuity have been made by all the warring nations toward finding substitutes for one thing and another. It had been the custom abroad until almost a year ago to use wheat or rye flour for thickening the electrolyte of dry batteries, but since there is now rather a scarcity of these cereals attention has been turned to other substances. Of these kieselguhr, water-glass, gelatine, starch, sawdust and glass-wool seem to have proved satisfactory. One of these products, or an admixture of several of them, is used as the base or binder. For the electrolyte proper is used well-powdered salammoniac, calcium acetate, zinc chloride and thin refined glycerine in the proportion of about equal parts of salammoniac and the calcium acetate, 80 grams of each, 40 grams of the zinc chloride and 10 grams of glycerine. The mixture is stirred energetically after being covered with distilled water at a temperature of 40 deg. C. and until all solid matter is dissolved and thoroughly mixed in one concentrated solution, which is then allowed to be taken up by the binder, forming a paste which is then applied between the plates of the cell or battery to form the electrolyte. The whole is inclosed in a casing of paraffine fitted with vents for the escapement of gas. The addition of equal parts of calcium acetate and salammoniac is said to make a very satisfactory mixture, one which has high conductivity and does not crystallize, nor is it hygroscopic.

Motor Service in Constructing Grain Elevator

Hauling Sand and Gravel Cars, Unloading and Distributing Contents, Mixing and Distributing Concrete, Hoisting and Pumping Applications, Also Electrical Layout and Performance Data

MANY labor and time-saving applications of electricity which should be of interest to building contractors and central stations seeking new business have been employed in constructing a 10,000,000-bushel concrete grain elevator on the Calumet River, near Chicago. Involving as it does the pouring of 85,000 yd. of concrete, probably the most extensive concreting system ever utilized has been employed. Aside from indicating numerous methods of using motors in construction work this plant is remarkable in that it is operated entirely by electricity—a feature which has permitted considerable flexibility, economy and despatch in operations.

The installation has called for the construction of 223 tanks in three groups. One group is adjacent to the river and consists of tanks 22 ft. 6 in. in diameter by 105 ft. high. Another group contains 104 tanks of the same dimensions, while the third consists of ninety-five 15-ft. tanks, which are erected on top of the work house and extend to the same height as the other tanks. Ultimately seventy-eight tanks will be added to the central group, making 301 in all. These structures constitute the Calumet Terminal Elevator of the Chicago & Northwestern Railway, and are being constructed from the plans of the John F. Metcalf Company, engineers, by the Witherspoon-Englar Company and Grant Smith Company, joint contractors. When the elevators are completed they will be electrically operated from an isolated power plant and the installation will comprise some novel features in the way of special equipment and wiring. During construction work, however, energy is being furnished by the Commonwealth Edison Company under its limited form of contract.

The concreting plant, which comprises a system of belt conveyors that obviate the handling by hand of all materials except the cement, is shown quite fully in the illustrations of Fig. 3. The cars of sand and gravel are hauled onto the dumping platform by a single-drum hoist (Fig. 3A), which is driven by a 20-hp. slip-ring motor. Running beneath the hoppers is a 24-in. belt conveyor, which permits unloading three "battleship" type cars at a time, this being found necessary since emptying one car at a time could not supply the material as fast as it was used. The conveyor is driven by a 5-hp. induction motor and discharges onto a second 24-in. belt, driven by a 30-hp. motor, which conveys the material up an incline and dumps it into storage bins having a capacity of 1000 yd. of sand and 1800 yd. of gravel. The latter conveyor is 300 ft. long and runs over a traveling tripper, which deposits the material in the particular bins desired. Beneath the storage bins, where there is a hopper every 6 ft., runs a third conveyor, which delivers material to a long inclined belt (Fig. 3D), which in turn discharges into a hopper in the center one of the three towers. From this hopper material is delivered to belts running to hoppers in the two end towers or to a concrete mixer at the foot of the middle hoist tower.

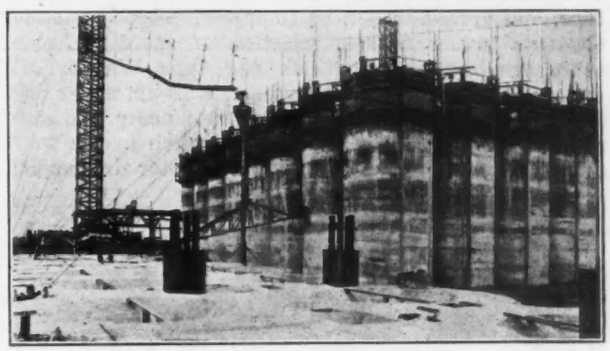


FIG. 2—TEMPORARY LAMP-CIRCUIT WIRING CARRIED ON STUDDING OVER TANKS

The understorage bin belt, which is 216 ft. long, and the incline belt, which is 120 ft. long, are driven by 15-hp. motors, and the lateral distributing belts, one 192 ft. and the other 187 ft. long, are operated by 10-hp. motors. Each of the three concrete mixers is driven by a 20-hp. motor. Single-drum, 1-yd. concrete bucket hoists are installed at each tower and each is driven by a 90-hp. motor capable of raising the bucket at the rate of 400 ft. per minute. When material has to be hoisted 140 ft., lifting, dumping and returning is accomplished in forty-six seconds, the mixer operations being timed so that a batch of concrete is ready and waiting on each return of the hoist bucket. In addition

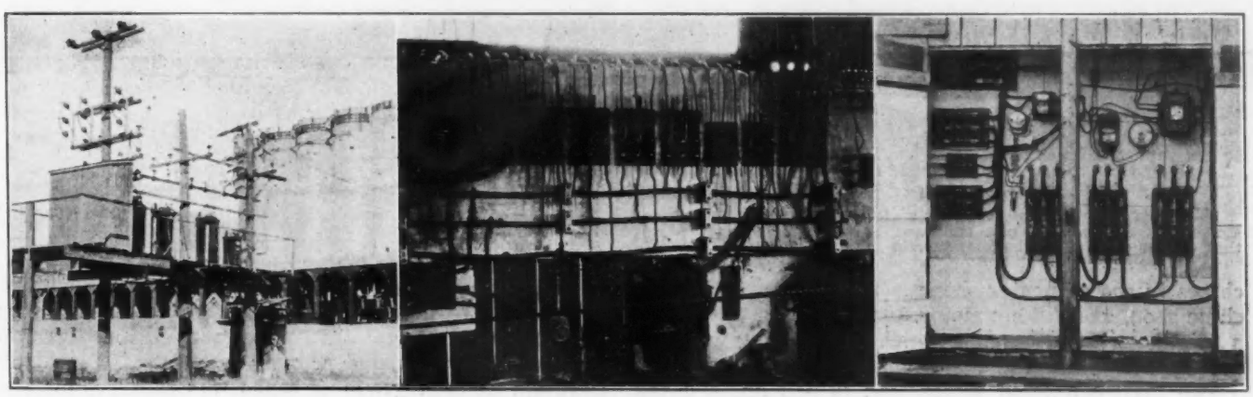


FIG. 1—ARRANGEMENTS TO USE ELECTRIC SERVICE DURING CONSTRUCTION OF GRAIN ELEVATOR

A—Substation for construction service. *B*—Switch controlling all belt conveyor motors. *C*—Main control board for all power and lighting circuits.

to the concrete hoists there is a double-drum hoist driven by a 35-hp. motor on one of the towers for hoisting lumber and miscellaneous equipment.

TYPES OF MOTORS AND CONTROL

One of the principal features of the electrical installation is the use of Wagner BW starterless-type, three-phase induction motors on all belt conveyors, thus making it possible to control them through a bank of simple three-blade knife switches centrally located. In Fig. 1C are shown the knife switches which give the central hoist engineer complete control of the entire concreting system. Concentrating the control of all parts of the system has contributed considerably to the flexibility of operation and has permitted marked economies. All of the hoist motors are of the slip-ring, variable-speed type, and are controlled by compression-type resistance elements giving a wide selection of speeds. Among other applications in which the type Wagner BW motors are used are the following: A 10-hp. motor driving a three-stage, 200-gal.-per-minute pump and automatically controlled by a pressure switch in the water system at the mixer plant; a 10-hp. motor driving machines in the carpenter shop; a 3-hp. motor in the machine shop, and a 5-hp. motor, temporarily connected to a 60-gal.-per-minute pump, which is supplying water to the system while the main pump is being repaired.

The total connected motor load is 518 hp. and the energy consumption during six months of the construction work is indicated in the accompanying table.

RELATION OF ENERGY CONSUMPTION AND MAXIMUM DEMAND TO CONCRETE POURED

Month	Cubic Yard	Maximum Demand	Kilowatt-Hour Consumption Lighting	Power
April	588	68	75	2,672
May	5,426	89	142	7,768
June	9,913	77	124	6,474
July	5,441	77	16	6,809
August	19,854	114	4,265	22,880
September	7,866	70	1,970	13,280
Total	49,088		6,592	59,883
Lighting and power				66,475 kw.-hr.
Kilowatt-hour per yard of concrete				1.354
Average earned rate for energy consumption				2.843 cents
Cost energy per yard of concrete				3.849 cents

Power for operating the construction equipment is furnished as 12,000-volt, three-phase energy, the voltage being stepped down through the substation shown in Fig. 1A to 230 volts for local distribution. Three 100-kw. delta-connected, single-phase transformers care for the motor demands and a 50-kw. transformer energizes the 110-220-volt, three-wire lighting system. The main control board shown in Fig. 1C is inclosed in the shelter seen on the ground at the far end of the substation in Fig. 1A. The main 230-volt power circuit is connected with a 1000-amp., three-blade switch and branches into three feeder circuits, one for each mixer plant. Three 350,000-circ. mil cables supply the central plant, three cables of the same size the east plant, and three No. 4/0 cables the west plant. These are carried on a temporary wooden pole line. The main switchboard as well as each of the three mixer and hoist plants are fused simply for protection against abnormal overloads. The main board is equipped with power and lighting meters and a contact-making clock meter recording the demand by half-hour periods.

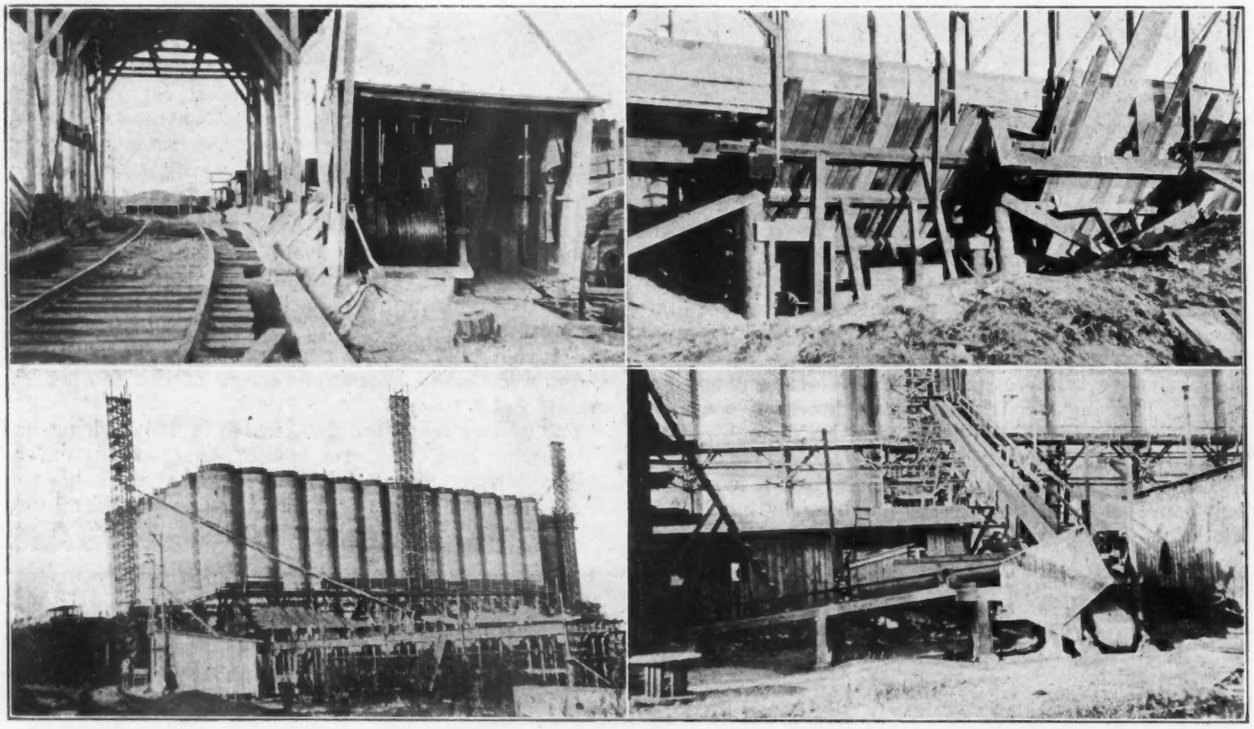


FIG. 3—EXAMPLES OF MOTOR OPERATED EQUIPMENT USED IN CONSTRUCTING LARGE GRAIN ELEVATOR

A—Apparatus for hauling sand and gravel car onto dumping platform. B—Dumping platform under which is motor-operated conveyor. C—Inclined belt conveyor which conveys material from dumping bins to storage bins. D—Conveyor from storage bins that dumps on inclined belt leading to tower distributing conveyors.

Construction work on the storage tanks was carried on twenty-two hours of each day, which accounts for the very large energy consumption for lighting in those months when extensive pouring was done. Since the elevation of each group of tanks was raised simultaneously, it requires about 600 lamps to light the area occupied by the 104 tanks and the other points of activity about the plant. Most of the lamps used were 60-watt units. The wires supplying those on the elevator itself were carried on temporary studding fastened to the pouring platform, with brackets and knob construction as shown in Fig. 2.

The electrical layout was made jointly by Louis Falzer, electrical engineer of the Thomas Elevator Operating Company, and Cecil Hodgson, electrical engineer of the Witherspoon-Englar Company. J. K. Thompson was superintendent of the work for the contractors.

Plant Arrangements that Permit Continuous Production Flow

How Supervision of Electrical Equipment Covering 2,000,000 Sq. Ft. of Space Is Vested in Six Men; How Apparatus and Control Is Standardized, and Provisions Made for Assuring Continuous Operation in Crane Company's New Chicago Plant

BY H. S. STEWART
Electrical Engineer Crane Company, Chicago, Ill.

THE Crane Company's new plant at Chicago is a novel example of how equipment can be arranged and controlled to insure uninterrupted operation and permit a continuous flow of material through the successive production processes. Owing to the type of control used the workmen need have no training in starting motors and may thus devote their entire time to productive operations. Another feature of the installation is the extremely low maintenance expense involved. This is due in part to centralizing the supervision of all electrical equipment, which includes 10,000 hp. in motors distributed over 2,000,000 sq. ft. of area in six men. Standardizing equipment and methods of installing it has also aided in holding down this expense, since it permits carrying less spare parts in stock and simplifies diagnosing and remedying troubles. It is interesting to point out that purchased energy is used exclusively for operating this plant, the Crane Company believing in specializing in manufacturing and not extending its field to include another specialized industry —the generation of electricity.

As outlined on page 921 of the April 22 issue of the ELECTRICAL WORLD special consideration has been given at this plant to securing more than one source of energy supply and to providing a distribution system that would allow for extensions to the plant. The substations have been located approximately in the center of each group of buildings. Energy is delivered to each of these at 12,000 volts and stepped down to 220 volts by transformers whose secondaries are delta connected with the middle point of one phase grounded. Reliability of service is increased by having two banks of transformers at each substation, either of which can carry the entire load. They are connected to separate buses but are normally operated in parallel so there would be no interruption to service if one bank was cut out of service, which is done automatically in case of faulty operation. Continuous operation is still further assured

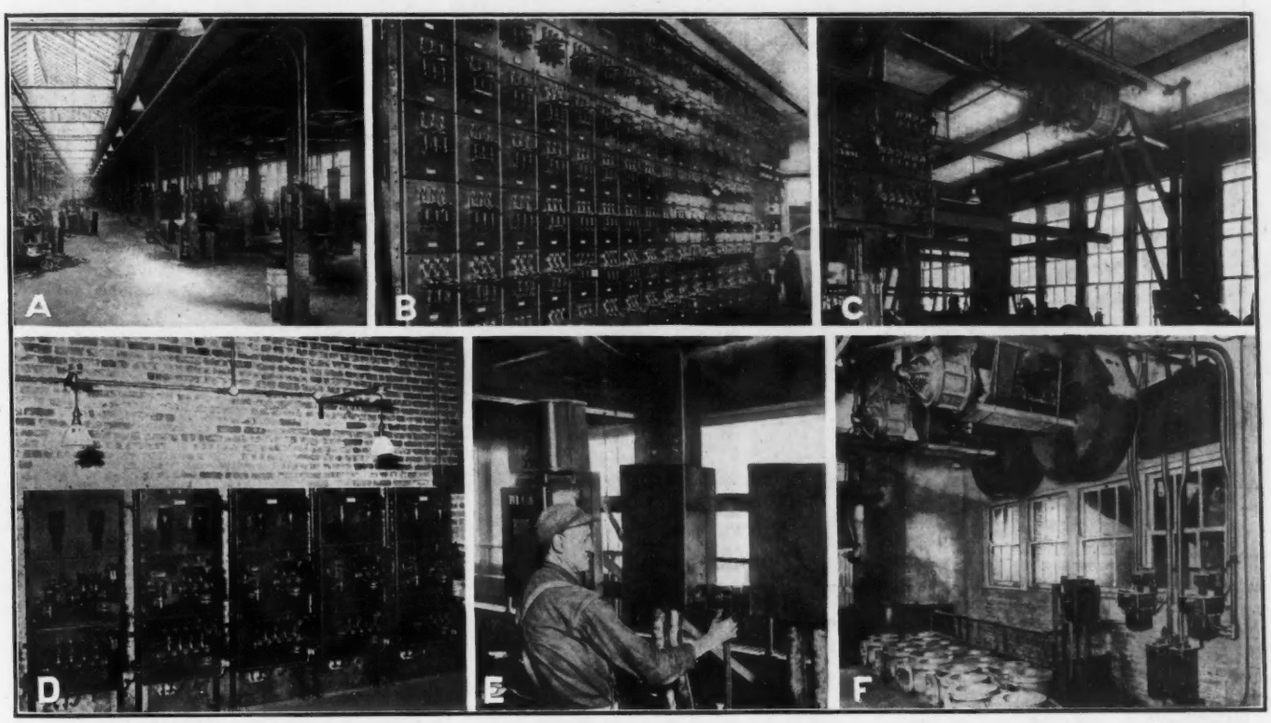


FIG. 1—CONTROL FEATURES OF MOTOR INSTALLATIONS THAT HAVE AIDED IN SPEEDING UP PRODUCTION IN CRANE PLANT

A—Typical production unit in nipple shop of Crane Company's Chicago plant showing totally inclosed safety-first, motor switches mounted on columns. These switches are provided with overload and low voltage protective features, have all wiring inclosed and are provided with conduit terminals. They are standard for all induction motors of 7.5 hp. and over in this plant. Each motor has a separate conduit line back to a control-board in a sectionalized switchboard room. Such a control-board is shown in *B*. The plant has six such departmental rooms where there is a three-coil circuit breaker for each motor in a particular section. This breaker may trip out and be replaced by the attendant before the motor stops rotating. In *C* is shown a reversible drive for a special tapping machine. The arrangement provides two speeds, 450 r.p.m. forward and 900 r.p.m. reverse. A solenoid brake mounted on the motor shaft gives quick stops and extreme accuracy of depth of the drilled hole. The automatic control panel is shown at the left. A battery of these machines have been in operation over a year, reversing four times a minute, eight hours a day, without repairs. *D*—In special cases it was desirable to operate motors from a distance. This is accomplished by push button control shown in *E* connected to automatic control panels shown in *D*. These panels are installed in a departmental switchboard room and automatically handle the starting conditions of the motors which may be otherwise operated by unskilled labor. *F*—This view shows motor-driven exhausters which collect dust from tumbling machines in the foundry. The switch at the left is standard for motors of 7.5 hp. The oil switches at the right over the drum controllers are used as line switches in series with the controllers for operating each of the variable speed motors on the ceiling, which are rated at 35 hp. This is a standard variable speed motor installation for the plant.

by running the feeders to each motor in separate conduits. Thus a fault on one circuit will not affect another, as often happens where several taps are made on each feeder. Since interruptions to plant operations would cause considerable loss due to reduction in output, fuses have been omitted from all motor circuits and centrally-grouped circuit breakers used instead. In case of an overload the switchboard attendant receives both red-light and gong signals and is thereby often enabled to restore the circuit breaker before the motor stops or the workman even knows of the interruption.

Where motors which require gradual acceleration are used remote control switches have been provided to permit the plant workmen to start or stop the motors by simply pushing a button. The automatic contactors which these button switches control are centrally grouped like the circuit breakers so they are under the supervision of the department switchboard attendant. Other motors, except those rated below 7.5 hp., are controlled by compensators having overload and no-voltage trip coils. The wiring to these switches is totally inclosed, being run in conduit. As a rule the compensators are mounted on columns near the motors they control. To facilitate identifying the control apparatus for each motor a painted label shows the location and number of the motor. For instance *D*3-S-350 refers to motor No. 350 on second floor of building D_3.

Practically every operation from winding the tower

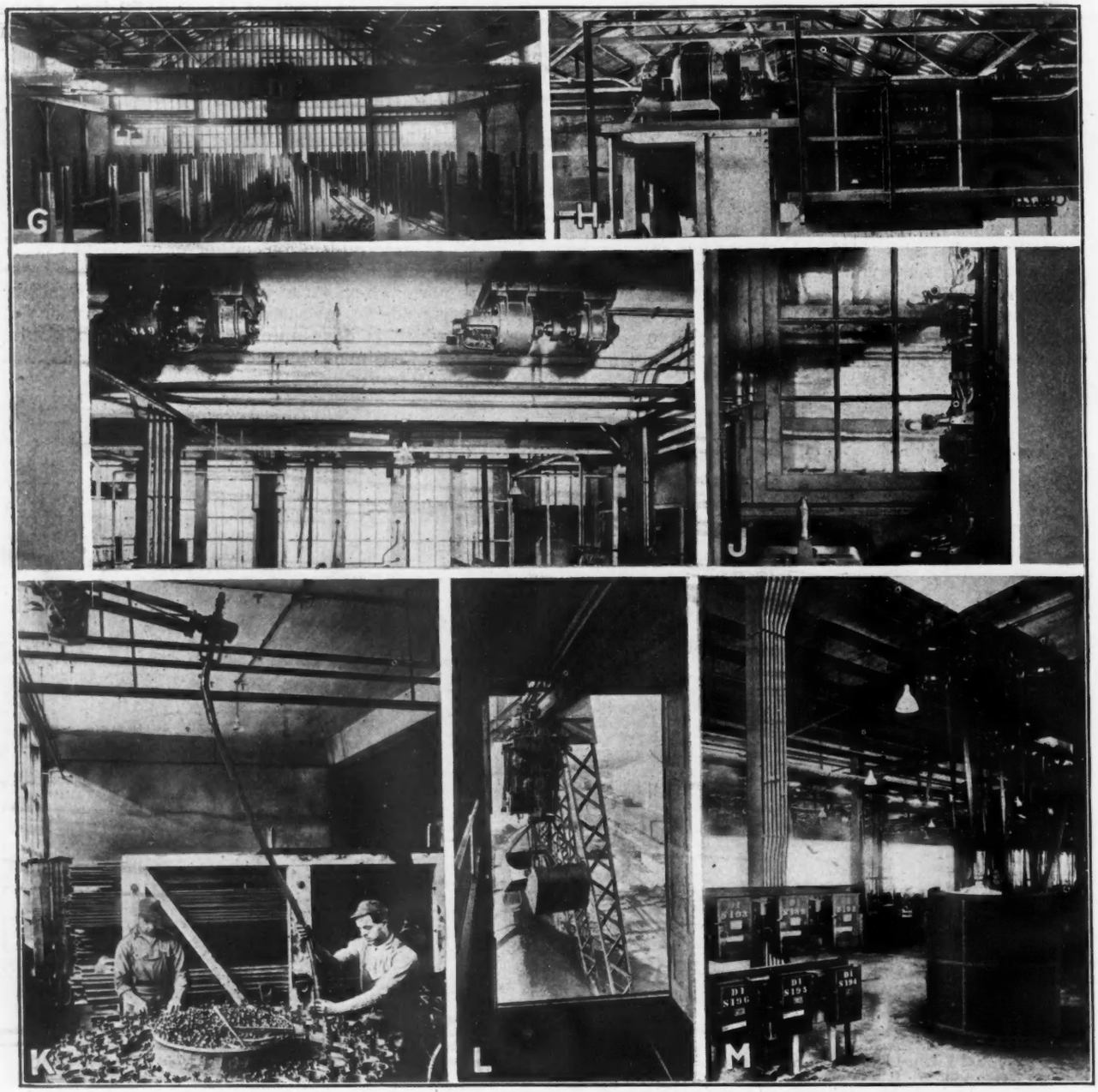


FIG. 2—AUTOMATIC CONTROL FOR CRANE AND SPECIAL MACHINES OPERATED BY STANDARD MOTORS IN CRANE PLANT

G—In the pipe stock room of the Crane plant a 5-ton, 90-ft. crane is operated without hooks—electromagnets do the lifting and are energized by a 3.5-kw. motor-generator set installed on the crane. *H*—An inclosed bridge type of motor used on the crane is shown in *H* mounted above the cab. This motor is rated at 30 hp., equipped with solenoid brake and controlled by the automatic panels shown at the right. Each of the three crane motors is provided with limit switch contacts, making it impossible for the operator to damage the crane through carelessness. As an additional protection one main line and three individual circuit breakers are installed in the cab as shown in *J*. In the plating room duplicate motor generator sets installed on the ceiling are shown in *I*. The machine illustrated in *K* is operated by a 0.5-hp. motor and turns down nuts on flange bolts at the rate of 100 per minute. The monorail crane in *L* supplies coal to a heating plant at the rate of 200 tons per day and is handled by one man. This crane is rated at 3 tons and is operated by four motors. The special milling machine in *M* requires six motors shown mounted on the ceiling. The starting switches at the left are standard for induction motors in the plant of 7.5 hp. and under.

clock to driving the most intricate tool is performed by electricity. By using this motive power, production speeds have been permitted which were previously unknown. Castings are dumped from the molds red hot and are conveyed, tumbled, sorted and delivered to the various machinery sections by electric trains operating at speeds up to 15 miles per hour. In the meantime, the sand has been removed, sifted, cooled and tempered and the scrap elevated and redeposited in a continuous-pouring furnace. Dust falling from the rotating tumblers is gathered by motor-driven exhausters at a cost which makes the dust a profitable by-product when sold to fertilizer manufacturers. The exhausters are driven by the two 35-hp. slip ring motors shown in Fig. 1, the speed being regulated by the drum-type controllers shown below the oil switches. This control equipment is typical of that employed for slip-ring motors of 25 hp. and up while the switch on the left is standard for 75-hp. motors.

Separating iron and brass filings is also performed by electricity. This is done by a rotating electro-magnet which separates the mixed filings into two piles, handling about one ton per hour. A 2-hp. motor rotates the sorting machine. Coal for the steam-heating plant is handled at the rate of 200 tons a day by a four-motor 3-ton Shepard monorail crane operated by one man. One set of two motors moves the trolley in and out of the building, the third motor operates the hoist, and the remaining motor opens and closes the clamshell bucket. To prevent interruptions in the electroplating department, duplicate motor generators have been provided. These are mounted on the ceiling and controlled by apparatus attached to nearby columns. Two years' satisfactory operation with this arrangement speaks well for the suitability of the location of this equipment.

One example of the way in which the plant production has been "speeded up" is the arrangement for reversing the tapping machines at twice the working speed, permitting a 25 per cent increase in production. The motor driving each machine is a two-speed alternating-current unit which operates 450 r.p.m. running forward and 900 r.p.m. reverse. A solenoid brake mounted on the motor shaft permits quick stops, thereby insuring extreme accuracy as to depth of hole drilled. The motor and automatic control apparatus used with one of these machines is shown in Fig. 1. A battery of these machines has been reversing four times a minute, eight hours a day, for over a year without requiring repairs of any kind on the electrical equipment.

A method of arranging six motors to drive a special milling machine is shown in Fig. 2. These units are attached to the ceiling over the machine and are controlled by the starting switches mounted on the angle-iron frame work at the left.

In the pipe warehouse is an interesting crane equipped with electro magnets instead of hooks. These are employed to do all the transporting and are energized by a 3.5-kw. motor-generator mounted on the crane. Three inclosed motors operate the crane, each being controlled by automatic contactors actuated by a master switch in the crane cage. Limit switches prevent over-running the motors. For additional protection one main-line and three individual circuit breakers are installed in the cage. Fabroil gears and pinions are used on all the cranes and on many motors throughout the plant.

To improve the power factor and thereby permit using the minimum allowable size cable a 600-kva. synchronous condenser will be installed in the new section of the plant. The arrangement will permit a net saving of $4,000 in cable investment. About 86 miles of cable is now installed. Suburban and lead-covered cable is used for underground circuits, while varnished cambric wire inclosed in metal conduit is employed for interior work.

Aside from the applications mentioned electricity is being used for operating a floor scrubber, driving a flexible shaft to turn down nuts, heating at inaccessible points, controlling water level in foundry tanks, operating a grinder used by the core-box repair man, preparing glue, and driving wood-working machines.

All squirrel-cage motors are General Electric type K.T. Those rated at 7.5 hp. and less are controlled by CR-1031 switches, while H-5 compensators with overload relays arranged for conduit wiring are used for motors rated at 7.5 hp. to 25 hp. Fractional horsepower motors are of the repulsion induction single-phase type. K-5 solenoid operated switches are used for underground low-tension feeders; K-12 oil switches for incoming line 12,000-volt service; and K-20 oil switches for slip ring motors 25 hp. and larger. All of the electrical apparatus belonging to the Crane Company was furnished by the General Electric Company, the installation being supervised by the writer.

Wattmeter Correcting for Transformation Losses

A singular type of wattmeter that enables one to measure the high-tension input from the low-tension output side is the work of an Austro-Hungarian inventor, Gino Campos of Milan, Italy. Ordinarily wattmeters are designed to indicate the input or output *in situ* by connecting the voltage and current coils to determine the watt factors at the point of measurement. However, by the disclosure made in patent No. 1,201,996 it becomes possible to measure the total input on the high-tension side of a transformer by merely connecting the wattmeter to the low-tension side of a transformer. In other words, the wattmeter automatically corrects for the transformer losses. This ingenious result is accomplished by simply compensating the voltage and current coils of the dynamometer by means of additional turns whose fields are proportional to the current and voltage respectively of the low-tension side. Because the copper losses of transformation are proportional to the square of the current, and the iron losses are substantially proportional to the square of the voltage, it is seen that such compensated winding can suitably add to the deflection reading of the wattmeter to make it measure both the low-tension output and the watts lost in the transformation of power.

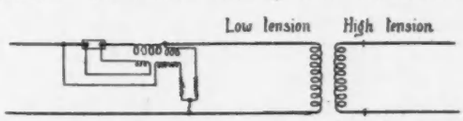


DIAGRAM OF CIRCUIT CONNECTIONS

Keeping Trial Irons from Coming Back

Of the 5000 electric irons sold by the central station at Youngstown, Ohio, last year only three came back. The men in the sales department believe the company's policy of requiring customers to return irons themselves, is responsible for this enviable record. The irons are put out on fifteen days' free trial and if customers ask for terms the payment is spread over two or three months. While it might be thought that many irons would be lost through this method, the records show that the money for only four irons out of the 5000 could not be collected. The people who had accepted these four irons on trial moved out of town before the first payment was due.

Theory and Operation of Split-Phase Magnet—III

Vector Relations for a Particular Form of Split-Phase Magnet, Its Holding Pull and Operating Conditions During the Starting Period

BY F. HYMANS

IN the sections of this article that have appeared in the Nov. 18, and Dec. 16, 1916, issues of the ELECTRICAL WORLD, the derivation of the vector diagram for split-phase magnet action was presented and a discussion of conditions which apply to a particular construction of magnet. In what follows here the holding pull and starting features are taken up.

As already shown in the previous section of this article (page 1194, Dec. 16 issue) no appreciable error is made when it is assumed that $\psi = \alpha$ of Figs. 8 and 9. Then $\angle OAD = 90$ deg. $+ \alpha$ and $\angle ADC = 180$ deg.

These conditions are assumed in Fig. 10a, on which considerations are now based, wherein angles and vectors correspond to actual test results. With $\angle OAD = 90$ deg. $+ \alpha$, and since $\angle GOC = \alpha$, the center of the locus circle will be the intersection of the perpendicular A_1M, bisecting OC, with the direction of OG, the vector of the open secondary exciting current.

It will be shown in Section IV that the best conditions occur when the secondary resistance is so proportioned that the point A becomes the intersection of the perpendicular MA_1 with the locus circle. Since then $A_1O = A_1C$, OAC becomes an isosceles triangle, so that

$$\angle COA = \frac{180 - \angle OAC}{2} = \frac{180 - (90 + \alpha)}{2} = 45 - \frac{\alpha}{2}$$

$$\varphi_{B_1} = OA = \frac{OC}{2 \cos COA} = \frac{OC}{2 \cos\left(45 - \frac{\alpha}{2}\right)}$$

$$= \frac{\varphi}{4 \cos\left(45 - \frac{\alpha}{2}\right)} \qquad (9)$$

Substituting in 9 for φ from 1, and for φ_{B_1} from 3, we obtain

$$ri_s = \frac{n_s e}{4 n_p \cos\left(45 - \frac{\alpha}{2}\right)} \qquad (10)$$

Further in the isosceles triangle OAC, $\varphi_{B_1} = CD + DA$, and hence by 9 $\dfrac{\varphi}{4 \cos\left(45 - \frac{\alpha}{2}\right)} = CD + DA$. Substituting for φ from 1, CD from 6 and DA from 7, after replacing in 7 φ by α, we obtain

$$i_s = \frac{n_p i e}{n_s\,(4L\omega n_p^2 i \cos\alpha + e) \cos\left(45 - \frac{\alpha}{2}\right)} \qquad (11)$$

Eliminating i_s between 10 and 11, we derive

$$r = \frac{n_s^2}{4 n_p^2}\left(\frac{4L\omega n_p^2 i \cos\alpha + e}{i}\right) \qquad (12)$$

On a magnet with $n_p = 325$; $n_s = 15$; $i = 0.934$; $\alpha = 10° - 20'$; $L = 7 \times 10^{-6}$, an emf. of 161.8 V at a frequency of 60 cycles ($\omega = 120\pi$) was impressed. The secondary resistance was adjusted to produce the best holding pull, and it was found by actual measurement that $r = 0.65$ and $i_s = 3.78$ A. From 11 and 12, however, we calculate $i_s = 3.58$ A and $r = 0.68$, showing an excellent agreement, particularly since the rheostat used in the secondary could only be adjusted in steps.

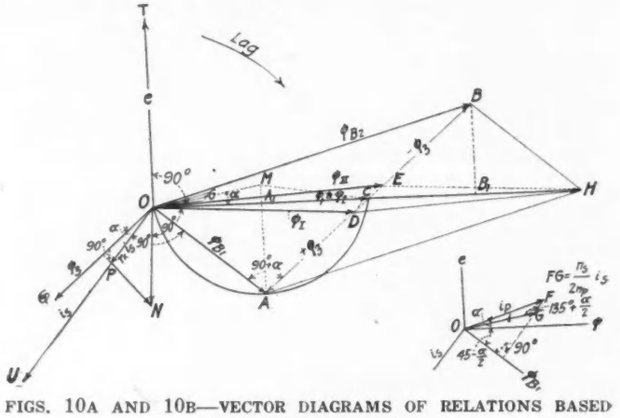
The primary current $i_p = OF$ is the resultant of the open secondary exciting current i and the vector $GF = n_s i_s / 2n_p$ (see equation 2). Since GF is parallel to OU, and therefore perpendicular to OA, it is easily found that therefore perpendicular to OA, it is easily found that $\angle OGF = 135 + \alpha/2$. For the sake of clearness these conditions are exaggeratedly shown in Fig. 10b, from which we derive

$$i_p = \sqrt{\left(\frac{n_s i_s}{2n_p}\right)^2 + i^2 - \frac{n_s i_s}{n_p} i \cos\left(135 + \frac{\alpha}{2}\right)} \qquad (13)$$

For $i = 0.934$ A, $\alpha = 10° - 20'$, and $i_s = 3.58$ A as calculated from 11, $n_p = 325$, and $n_s = 15$, we find from 13, $i_p = 0.999$ A. By actual measurement $i_p = 1.0$ A.

IV—HOLDING PULL OF THE SPLIT-PHASE MAGNET

The holding pull of the split-phase magnet is the load which the magnet can sustain without chatter. It is, of course, equal to the smallest instantaneous pull which the stationary part of the magnet exercises on the hinged part. It will be denoted by P_h, and will be measured at a point centrally between B_1 and B_2; that is, at a lever b from the fulcrum (Fig. 7). If we have in general a certain number of fluxes, of which the maximum values are φ_a, φ_b, φ_c, etc., and when the angles of



FIGS. 10A AND 10B—VECTOR DIAGRAMS OF RELATIONS BASED UPON TEST RESULTS

lead or lag in respect to a certain datum line are β_a, β_b, β_c, etc. the instantaneous value of each of the fluxes will appear in the general form $\Phi_a = \varphi_a \sin(\omega t + \beta_a)$, where t is the time. If further q_a, q_b, q_c, etc., are the pole areas for each of these fluxes, the resultant of the instantaneous magnetic pull will be expressed by

$$F = \frac{10^{-7}}{7.213} \sum \frac{\varphi_a^2}{q_a} \sin^2(\omega t + \beta_a) \text{ lb.}$$

which can be written

$$F = \frac{10^{-7}}{2 \times 7.213} \sum \frac{\varphi_a^2}{q_a} [1 - \cos(2\omega t + 2\beta_a)]$$

$$= \frac{10^{-7}}{14.426} \sum \frac{\varphi_a^2}{q_a} - \frac{10^{-7}}{14.426} \sum \frac{\varphi_a^2}{q_a} \cos(2\omega t + 2\beta_a)$$

The first part of the right hand member of the above equation requires merely algebraic addition of given quantities, while the second part is the vector addition of quantities of double frequency and double lead or lag, which may be obtained by means of the ordinary graphical process. The minimum value of F which we

so obtain is the holding pull. We can apply the above to the split-phase magnet for each position of the point A on the locus circle and so determine in which position of A the greatest holding pull occurs. The process is, however, laborious and does not show the influence of the various quantities. A strict mathematical treatment, on the other hand, offers no especial difficulties, but does not result in a formula sufficiently simple for practical purposes. A very close approximation may be had as follows: We have already observed that phase and magnitude of the fluxes φ_I and φ_{II} at the poles A_1 and A_2, as well as of the fluxes φ_{B_1} and φ_{B_2} at B_1 and B_2, are such that their resultant is always the total flux φ linking with the primary (Fig. 10a). The nearer the point A is to C, the nearer are angles COE and COD, and also the angles COB and COA alike, and the nearer will it be true that the least instantaneous pull is exercised on the hinged arm of the magnet at the instant when the instantaneous value of φ is zero. At such instances, however, the pull due to the fluxes φ_I and φ_{II} may for all practical purposes be neglected, as these fluxes are never materially out of phase with φ. We shall, consequently, only have to consider the pulls due to the fluxes φ_{B_1} and φ_{B_2} at the poles B_1 and B_2. When we select OH in Fig. 10a for the datum line, and define

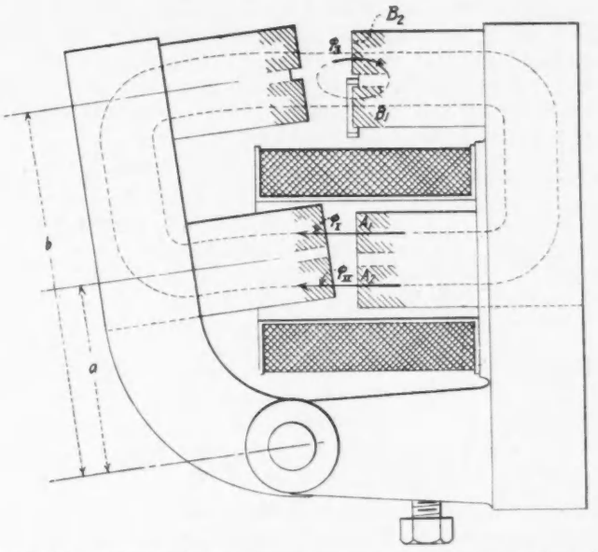


FIG. 11—SPLIT-PHASE MAGNET SHOWN IN STARTING POSITION

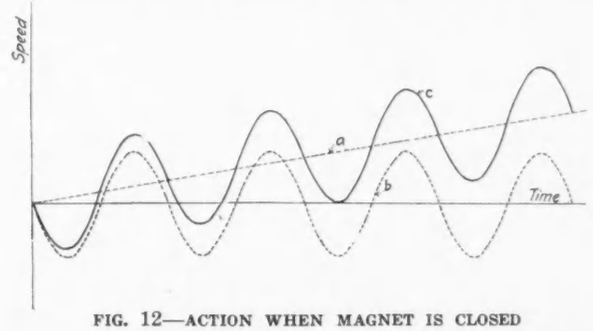


FIG. 12—ACTION WHEN MAGNET IS CLOSED

the instantaneous values to be the projection of the vectors on the axis OT, the instantaneous value of φ will be zero when its vector coincides with the datum line as in Fig. 10a. At this instant the instantaneous values of φ_{B_1} and φ_{B_2} will be the projection of OA and OB on OT, and will be numerically equal to AA_1 and BB_1 respectively, each of which being perpendicular to OH. Moreover, since $AC = CB$, $AA_1 = BB_1$, and when Q (in square inches) is the pole area of B_1 as well as of B_2, the total magnetic pull P_h will be expressed by

$$P_h = \frac{10^{-7}}{7.213Q}(AA_1^2 + BB_1^2) = \frac{2 \times 10^{-7}}{7.213Q} AA_1^2 \text{ lbs.} \quad (1)$$

and will act at a point centrally between B_1 and B_2 at a lever b from the fulcrum of the hinged arm. The force P_h will be greatest when AA_1 is largest, which evidently is the case when the point A is the intersection of the locus circle with MA_1, the perpendicular to OH at a point A_1 for which $OA_1 = \frac{OC}{2} = \frac{\varphi}{4}$, whence $\angle COA = 45 - \frac{\alpha}{2}$ (see section paragraph 3). Further, in Fig. 10a

$$AA_1 = OA_1 \tan COA = OA_1 \tan\left(45 - \frac{\alpha}{2}\right)$$

$$= \frac{\varphi}{4}\tan\left(45 - \frac{\alpha}{2}\right) = \frac{\varphi}{4}\sqrt{\frac{1 - \sin\alpha}{1 + \sin\alpha}}$$

or since $\varphi = \frac{e10^8\sqrt{2}}{n_p\omega}$ we find $AA_1 = \frac{e10^8\sqrt{2}}{4n_p\omega}\sqrt{\frac{1 - \sin\alpha}{1 + \sin\alpha}}$

Substituting for AA in 1, we obtain

$$P_h = \frac{10^8 e^2}{28.852 n_p^2 \omega^2 Q} \cdot \frac{1 - \sin\alpha}{1 + \sin\alpha} \quad (2)$$

Referring again to Fig. 10a, AA_1 is also numerically equal to the projection of CA on OT, and is therefore also the instantaneous value of CA at the instant when the instantaneous value of φ is zero. But CA is the resultant of the small vector CD and the vector $DA = \varphi_s$. The holding pull is therefore mostly all due to the secondary leakage flux φ_s, and its reluctance should therefore be made as small as possible. This requires that the slot for the secondary be made narrow and centrally with the core. In addition the abutting cores at B_1 and B_2 should be scraped to a perfect fit. It should be noted that (1) is derived on the supposition that the flux φ_s is uniformly distributed over the pole areas B_1 and B_2. This is not exactly the case, as it is clear that a line of force which closes right around the slot has a considerably shorter path than, for instance, the line which has been marked φ_s in Fig. 7. It can be shown that the distribution of φ_s over the width w of the poles B_1 and B_2 occurs approximately according to a rectangular hyperbola with the greatest density at the edges of the slot. Nevertheless, (2) is in substantial accord with tests. With $Q = 1.625$ sq. in.; $n_p = 325$; $\alpha = 10° - 20'$; $e = 161.8$ at a frequency of 60 cycles, we find from 2

$$P_h = \frac{10^8 \times 161.8^2}{28.852 \times 325^2 \times 120^2 \times \pi^2 \times 1.625} \cdot \frac{1 - \sin 10° - 20'}{1 + \sin 10° - 20'} = 25.9 \text{ lb.}$$

By tests P_h was found to be 28.5 lb. It will also be noted that P_h as expressed by equation 2 is independent of the number of secondary turns. This is, of course, quite natural; an increase in the number of secondary turns will proportionally increase the secondary induced emf., but the number of induced volts per turn remains the same.

V—CONDITIONS AT THE START AND THE STARTING PULL OF THE SPLIT-PHASE MAGNET

In Fig. 11 the magnet is shown in the starting position with a considerable air gap at the poles. It will be seen that most of the flux φ_s now closes through the air without linking with the hinged core. So far as the pull is concerned this flux is practically without effect. For the calculation of the starting pull we have, therefore, only to contend with a flux φ_I at A_1 as well as at B_1, and with the flux φ_{II} at A_2 as well as at B_2. Owing to the very small phase displacements (particularly under starting conditions) of these fluxes with OC (Fig.

10a), the magnet will act for all practical purposes as a purely single-phase magnet with a flux $OC = \frac{\varphi}{2}$ passing through each of the four poles. On this basis our further calculations will be based. In order to derive an equation for the starting pull, it will be necessary that we consider the motion of the hinged arm when the primary is excited. As the motion is of secondary importance in these considerations, we shall choose the initial conditions as simple as possible, and shall assume that the primary is closed at the instant when the instantaneous value of φ is zero and that the movable arm of the magnet is at rest in the position of Fig. 11, but free to swing in either direction. The instantaneous value of OC will, under these conditions, be expressed by $\frac{\varphi}{2} \sin \omega t$, and will cause at each of the poles a force f determined by

$$f = \frac{\varphi^2 10^{-7} \sin^2 \omega t}{4 \times 7.213Q} = \frac{\varphi^2 10^{-7}(1 - \cos 2\omega t)}{8 \times 7.213Q} \text{ lb.}$$

The forces exerted at the poles A_1 and A_2 combine to a resultant $2f$, whose point of application will lie at a distance a from the fulcrum. Similarly there will be a resultant pull $2f$ acting centrally between the poles B and B_2 at a distance b from the fulcrum. Reduced to the latter point the resultant of all magnetic forces acting on the hinged arm will be expressed by

$$F = \frac{2af}{b} + 2f = \frac{2(a+b)}{b} f$$

Substituting for f,

$$F = \frac{(a+b)\varphi^2 10^{-7}(1 - \cos 2\omega t)}{4 \times 7.213bQ}$$

and hence

$$F_{max} = \frac{(a+b)\varphi^2 10^{-7}}{2 \times 7.213bQ} \qquad (1)$$

If P_s is the load on the hinged arm, m the mass and v the speed in feet per second, all reduced to the point b, we have

$$F - P_s = m\frac{dv}{dt}$$

Substituting for F,

$$\frac{(a+b)\varphi^2 10^{-7}(1 - \cos 2\omega t)}{4 \times 7.213bQ} - P_s = m\frac{dv}{dt}$$

and integrating

$$\left\{\frac{(a+b)\varphi^2 10^{-7}}{4 \times 7.213bQ} - P_s\right\}\frac{t}{m} - \frac{(a+b)\varphi^2 10^{-7}}{8 \times 7.213m\omega bQ} \sin 2\omega t = v \qquad (2)$$

When $P_s < \frac{(a+b)\varphi^2 10^{-7}}{4 \times 7.213bQ}$ the magnet will always pull in.

By plotting as in Fig. 12, the speed v against time, the quantity $\left\{\frac{(a+b)\varphi^2 10^{-7}}{4 \times 7.213bQ} - P_s\right\}\frac{t}{m}$ in equation 2 above will be the straight line a, and the quantity $\frac{(a+b)\varphi^2 10^{-7}}{8 \times 7.213m\omega bQ} \sin 2\omega t$ the harmonic b. The speed v is the sum of a and b, and is represented by c. At first the speed is alternately negative and positive, showing that the hinged arm of the magnet alternately drops back and moves forward. After a certain lapse of time, depending on how much smaller P_s is than $\frac{(a+b)\varphi^2 10^{-7}}{4 \times 7.213bQ}$ the speed goes no longer through zero and the magnet rapidly closes. For

$$P_s = \frac{(a+b)\varphi^2 10^{-7}}{4 \times 7.213bQ} \qquad (3)$$

we have by equation 2

$$v = -\frac{(a+b)\varphi^2 10^{-7}}{8 \times 7.213m\omega bQ} \sin 2\omega t$$

The speed is now only a harmonic; the magnet arm will vibrate with a period of double the frequency of the impressed emf., but will not close. The force P_s as expressed by 3 is the starting pull at a point centrally between B_1 and B_2. The magnet will start and close against any load smaller than P_s, and the smaller the difference between starting pull and load the longer will it require for the magnet to close and the less will be the slam at the instant of closing.

From equations 1 and 3 we obtain $P_s = \frac{F_{max}}{2}$, showing that the starting pull corresponds to one-half the maximum instantaneous pull. Substituting for φ in 3, we have,

$$P_s = \frac{(a+b)e^2 10^9}{14.426bQn_p^2\omega^2} \text{ lbs.} \qquad (4)$$

Comparing the starting pull as expressed by equation 4 with the holding pull as in equation 2 of section IV, we have

$$P_h = \frac{b}{2(a+b)} \cdot \frac{1 - \sin \alpha}{1 + \sin \alpha} P_s \qquad (5)$$

showing that the greatest holding pull of the ordinary split-phase magnet is only a fraction of the starting pull. For the magnet of Fig. 7, with $a = 4''$; $b = 7\frac{7}{8}''$; $e = 161.8V$; $Q = 1.625$; $n_p = 325$, and $\omega = 120\pi$, we obtain from equation 4: $P_s = 112.9$ lb. against a calculated holding pull of 25.9 lb. The design of a split-phase magnet must consequently be based on the holding pull. Necessarily the starting pull will be greatly in excess of what is needed so that these magnets close with great violence.

The greatest instantaneous pull at the start being twice the starting pull, we obtain for the above example $F_{max} = 225.8$ lb., showing that for a comparatively small holding pull of only 25.9 lb. the magnet has to sustain considerable forces, requiring a very substantial construction of frame and core.

GRAPHICAL DESIGN OF DIRECT CURRENT BUSBARS

Charts for Determining Proper Current Densities and for Comparing the Suitability of Copper and Steel Where Mechanical Strength Is a Consideration

BY B. B. HOOD
Assistant to Superintendent
U. S. Metals Refining Company, Chrome, N. J.

When it is necessary to install large amounts of copper to transmit electrical energy special consideration should be given to the interest on investment, rate of amortization and cost of power lost, so that the most economical cross-section can be determined. Since for direct-current conductors the interest and amortization vary directly as the size of the conductors and the power loss inversely, the sum of these quantities will be a minimum when the interest plus amortization equals the value of the power lost. Other conditions which have to be taken into account, however, to obtain the most economical installation are the conductivity of the conductor metal and temperature which it is permitted to attain. With so many conditions involved it is usually a laborious task to determine the most economical current density to use. Chart I has been devised to simplify this operation and eliminate the necessity of using any tables or making any calculations.

For example, assume that a copper busbar having a conductivity of 93 per cent (Matthiessen's Standard) is permitted to attain a temperature of 38 deg. C., and that copper costs 30 cents a pound. This cost of copper should be the complete installation cost, including labor, supports, insulators, etc., reduced to cents per pound basis. Then with interest plus amortization at 14 per cent and energy costing $40 per kilowatt-year, proceed as follows: Starting in the left-hand rectangle, follow the line marked with the permissible temperature (38) until it intersects the diagonal line (93) representing the conductivity. Next multiply the cost of copper per pound (30) by the sum of the interest and amortization (14), giving 420, and follow the diagonal line marked with this value until it intersects the line drawn parallel to the side of the chart from the first point of intersection mentioned. Then continue perpendicular to this line until meeting the line marked with the cost of energy per kilowatt-year (40). From this intersection trace parallel to the diagonal lines of the chart to the current-density curve. Below or above this point, depending where the curve is intersected, will be found the proper current density (665).

Another use for this chart is the determining of the yearly loss caused by operat-

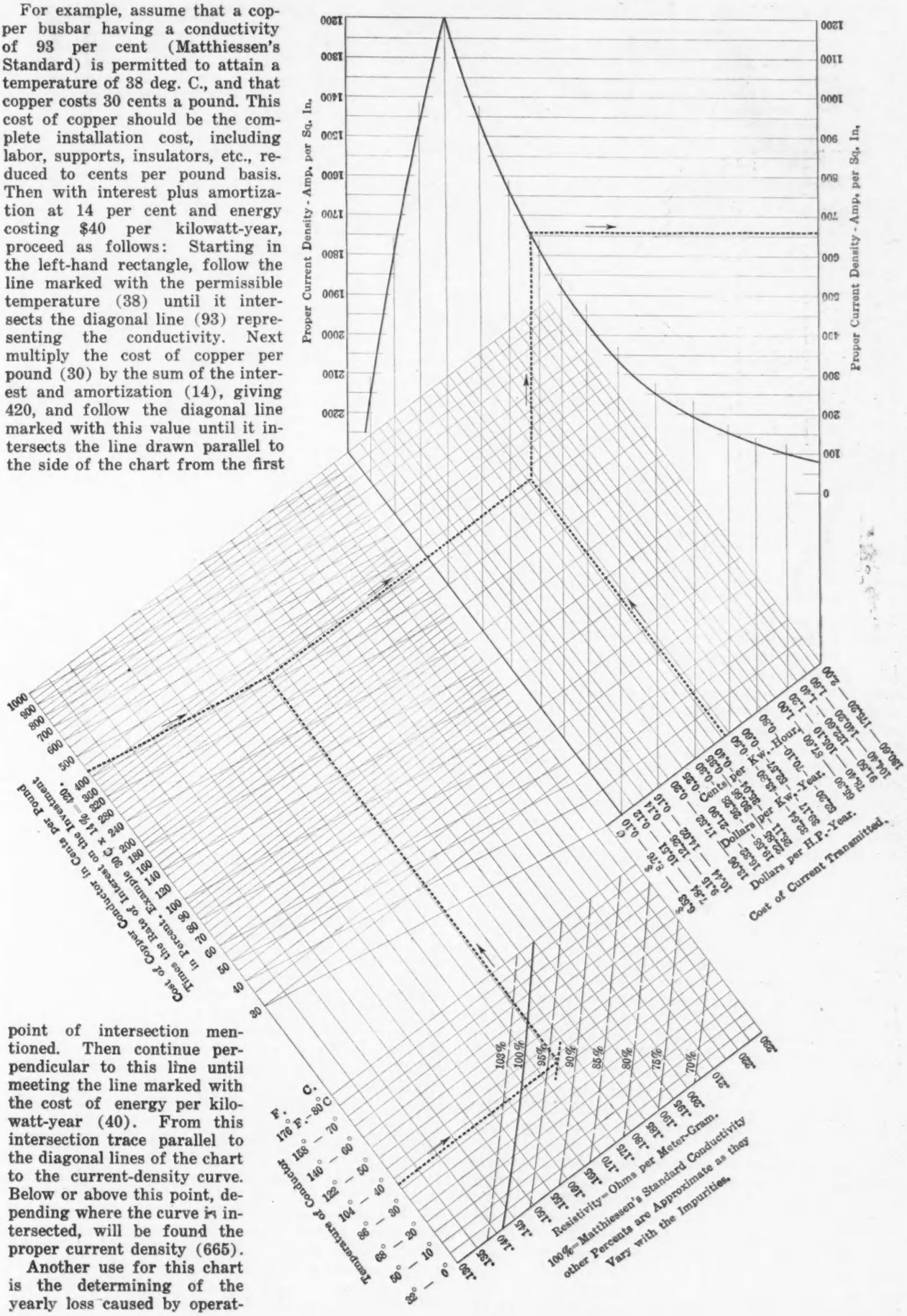

Proper Current Density - Amp. per Sq. In.
Proper Current Density - Amp. per Sq. In.
Cost of Current Transmitted.
Dollars per H.P.-Year.
Dollars per Kw.-Year.
Cents per Kw.-Hour.
Cost of Copper Conductor in Cents per Pound
Time the Rate of Interest on this Investment is Percent. Example 30 C x 14% = 420.
Temperature of Conductor
F. C.
Resistivity—Ohms per Meter-Gram.
100%—Matthiessen's Standard Conductivity
other Percents are Approximate as they
Vary with the Impurities.

CHART 1—PROPER CURRENT DENSITY FOR COPPER BUSBARS OR CONDUCTORS

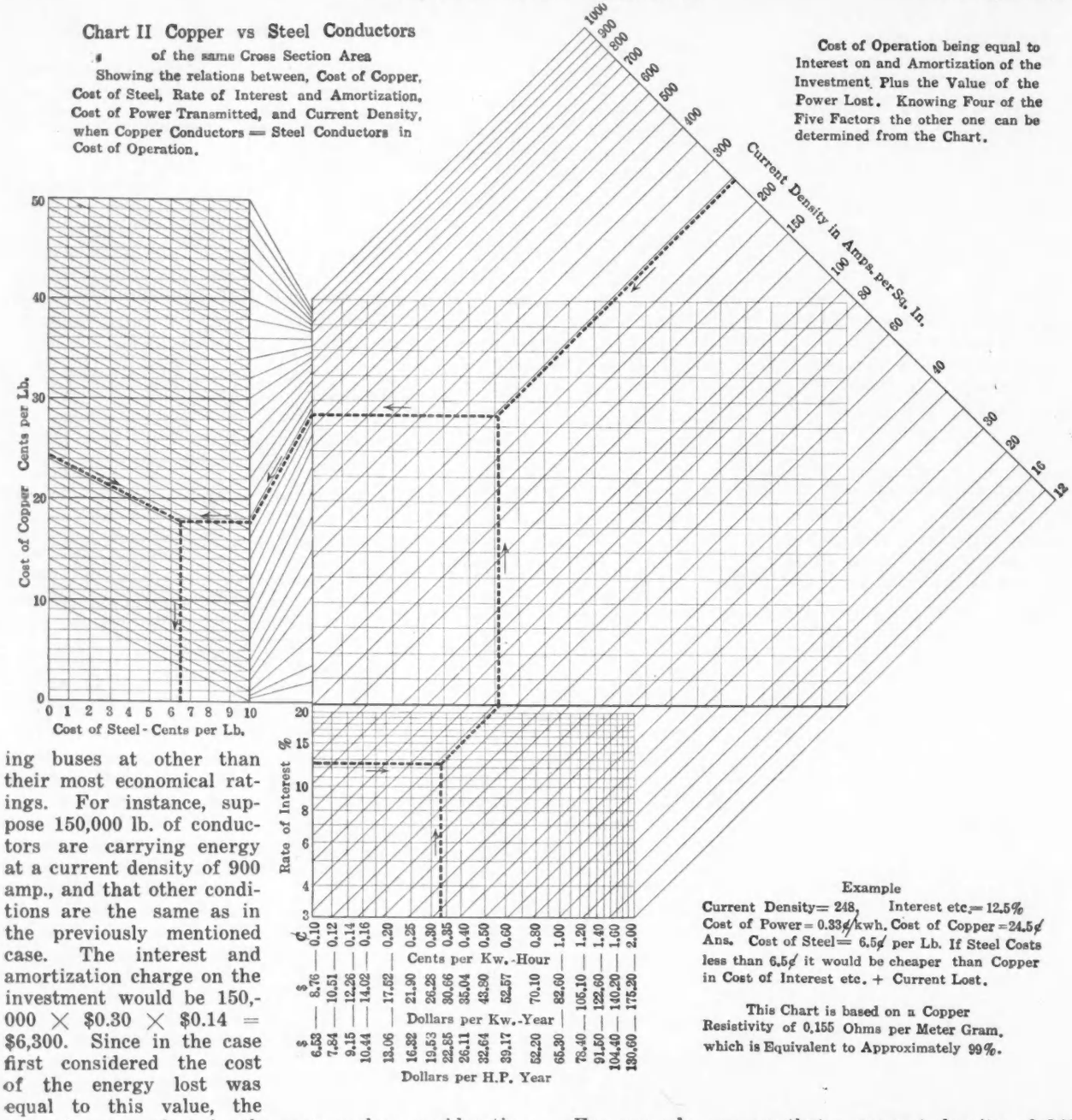
Example:—Copper busbar having a conductivity of 93 per cent (Matthiessen's Standard) to be operated at an average temperature of 38 deg. C. Cost of copper = 30 cents per pound. Interest + amortization of investment = 14 per cent. Cost of current = $48.00 per kilowatt-year. Proper current density = 665 amp. per square inch

Chart II Copper vs Steel Conductors

of the same Cross Section Area

Showing the relations between, Cost of Copper, Cost of Steel, Rate of Interest and Amortization, Cost of Power Transmitted, and Current Density, when Copper Conductors = Steel Conductors in Cost of Operation.

Cost of Operation being equal to Interest on and Amortization of the Investment Plus the Value of the Power Lost. Knowing Four of the Five Factors the other one can be determined from the Chart.



Example

Current Density = 248, Interest etc. = 12.5%
Cost of Power = 0.33¢/kwh. Cost of Copper = 24.5¢
Ans. Cost of Steel = 6.5¢ per Lb. If Steel Costs less than 6.5¢ it would be cheaper than Copper in Cost of Interest etc. + Current Lost.

This Chart is based on a Copper Resistivity of 0.155 Ohms per Meter Gram, which is Equivalent to Approximately 99%.

ing buses at other than their most economical ratings. For instance, suppose 150,000 lb. of conductors are carrying energy at a current density of 900 amp., and that other conditions are the same as in the previously mentioned case. The interest and amortization charge on the investment would be 150,000 × $0.30 × $0.14 = $6,300. Since in the case first considered the cost of the energy lost was equal to this value, the cost of energy lost in the case under consideration would be $(900 \div 655)^2 \times \$6{,}300 = \$11{,}890$, since the power loss varies as the square of current. This makes a total yearly charge of $18,190, but makes no allowance for the increased temperature of the conductors which would result when carrying larger currents and affect the conductivity and energy loss. If the installation were made for 655 amp. per square inch, there would be $(900 \div 655) \times 150{,}000 = 206{,}200$ lb. of copper installed. This would carry an interest, amortization and power loss charge of $17,320. Consequently the yearly loss with the installation under consideration is $870.

Sometimes a copper conductor or busbar whose size is determined as aforementioned is required to support a weight greater than its dimensions will permit, for instance, a cathode in an electrolytic refining plant. In such a case it may be advisable to consider steel, provided there are no conditions that prohibit its use. From a conductivity standpoint it can be determined whether steel can compete with copper by using Chart II, in which conductors of copper and steel having the same cross-section area are compared.

For example, assume that a current density of 248 amp. per square inch will exist in steel or copper of the dimensions required for mechanical reasons, that interest plus amortization amounts to 12.5 per cent, that energy costs 0.33 cents per kilowatt-hour, and that copper costs 24.5 cents per pound. Then the price at which steel can compete with copper will be found as follows: Find where the lines indicating the rate of interest (12.5) and cost of power (33) intersect, then continue along diagonal line to adjacent chart border, at which point continue vertically until the diagonal line marked with current density (248) is met. From this point trace horizontally to the edge of the chart, then along diagonal to the chart on left. At this point trace horizontally again until meeting the diagonal line marked with the cost of copper (24.5). Under this point of intersection is the price (6.5) at which steel can compete with copper.

This situation exists to a very large extent because a lower current density is used than would be proper if the conditions upon which the Chart I is figured were all that were considered, instead of bringing in the question of strength.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

OUTFIT FOR CABLE SPLICERS

Features of Cable Splicers' Tools and Construction Details of Compound Kettles and Solder Pots Developed by New York Companies

In conjunction with the New York Edison Company the United Electric Light & Power Company has developed a kit of cable splicers' tools which embodies some of the latest ideas on this equipment. Improved designs of compound kettles, solder pots and furnaces have also been adopted. Most of the equipment employed is shown in Fig. 1. Under working conditions the tool kits are stacked on the curb nearest the manhole and the furnace shield turned with the opening toward the manhole. A list of the tools is tabulated herewith. Part of the tools are insulated with vulcanized rubber or have wood handles so they may be used in working on "live" conductors. It may be pointed out that the tools are tested monthly and kept in working condition. The splicers are required to sign for the tools.

Some of the more interesting tools are shown in detail in Fig. 2. The safety hook *A* has a peculiarly shaped hook on its lower end, which when hooked into the bail of a solder pot or tool pan will not unhook accidentally. This hook is attached to the lowering or hoisting line by sister hooks. Tools *B* and *C* are for lining up the corresponding conductors of three conductor cables that have to be joined. The link joining the jaws of tool *C* is permanently secured in a slot in one jaw, but can be disengaged from the other jaw so the jaws may be placed around conductors in inaccessible places. The hack saw *E* has a seasoned hardwood handle so it may be used on energized cables. Stripping knife *F*, screw driver *G*, pliers *H*, paper insulation cutters *I* and *K*, and wire cutter *J* are provided with vulcanized rubber handles. The insulation cutters are really pliers which have been equipped with cutting edges. The latter are so placed and shaped that they will just cut through the insulation and will not injure the conductors. Insulation cutter *K* is for cutting the belts of three conductor cables and cutter *I* for cutting the insulation around each conductor. Tool *M* is a wood device for belling the ends of joint sleeves. Soldering iron *L* has a wood handle. The handle of ladle *D* is wrapped with oiled cambric so the heat conveyed up the handle from the solder will not burn the splicer's hand. Tool *B*, which is a conductor bender, is made of fiber.

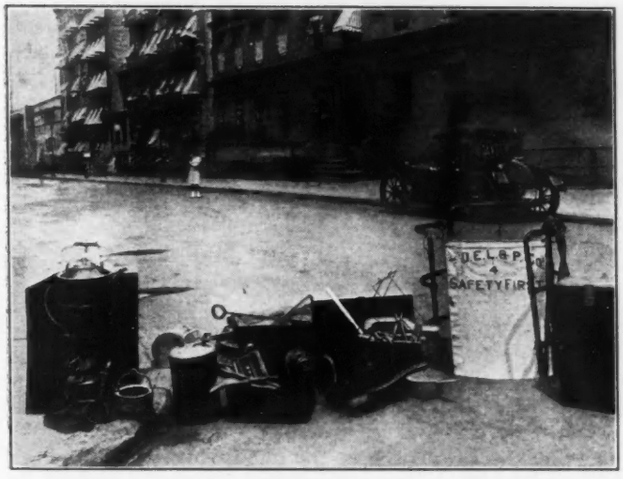


FIG. 1—EQUIPMENT USED BY NEW YORK CABLE SPLICERS

On the extreme left of the illustration are the furnace, compound kettle and furnace windshield. At the lower right hand corner of the shield are the solder pot and a ladle. Farther to the right arranged in the order named are the safety gasoline tank, testing equipment kit, tool kit (with some equipment displayed on top and in front), manhole guard and danger signal, ventilating curtain and furnace cabinet. Back of the testing kit may be seen the hooks for removing manhole covers.

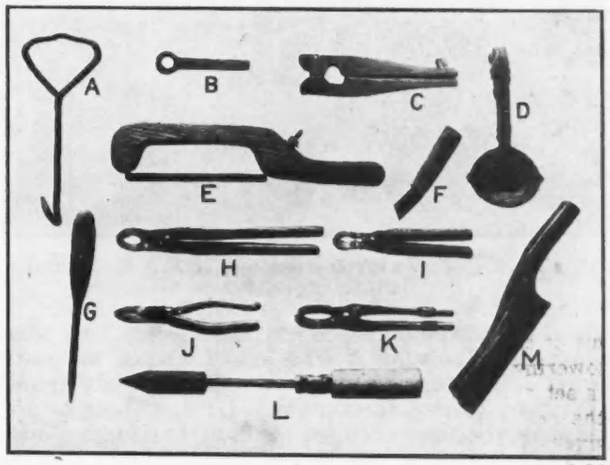


FIG. 2—SOME CABLE SPLICERS' TOOLS

LIST OF TOOLS USED BY CABLE SPLICERS

One furnace	One safety oil can, 3-gal.
Two ladles, 4-in.	Two wiping cloths, 3-in.
One pot hook	Two wiping cloths, 4-in.
One pot rope	Two wiping cloths, 6-in.
One conduline kettle	One rule, 2 ft.
One test lamp	One looking glass, small
One catch pan	One small funnel
One catch pan with hook	One chipping knife, small
One hacksaw frame, 12-in. (not insulated)	One tarpaulin
	One ladder
One wood hack saw frame, 8-in.	One disk signal
One soldering iron and handle	One bender
One chipping knife (large)	One star drill, 0.5-in.
One pair gas pliers, 12-in.	One cold chisel, 0.5-in.
One pair armour cutters	Two subway hooks
One riveting hammer, No. 1	One windshield
One ball peen hammer, No. 4/0	One solder pot
One saucepan	One canvas ventilating shield
One turnbuckle with guard rail	One pair cutting pliers
One rasp	One screwdriver, small
One file	One metal furnace box
One shave hook	One metal tool box
One dresser	One paper knife
One screwdriver (large)	One pair rubber gloves
One lead saw	One pair canvas gloves

In Fig. 3 are shown close-by views of the compound kettle, furnace, solder pot, exploring set and drip pan. The compound kettle, which is made of welded sheet metal, is constructed so that heat is applied on all sides as well as around the spout, and the cover is so designed that gases may escape but water cannot enter. Both of these features have been provided by making the kettle, cover and spout with double walls, the outer of which is perforated near the mouth of the spout and also around the cover, so heated gases can circulate between the walls and escape through the holes. The inner wall of the cover contains a hole for the escape of gases driven out of the kettle. Rain cannot get in this hole, however, since the outer wall covers the hole,

vents being provided around the rim. This construction permits using light-weight material that has little heat-storing capacity, since the gas jacket insures uniform heating of compound and prevents its cooling in the spout while being poured. The kettle is provided with a wood handle, so it may be handled without receiving a burn. A figure 8 loop is attached to the mid-

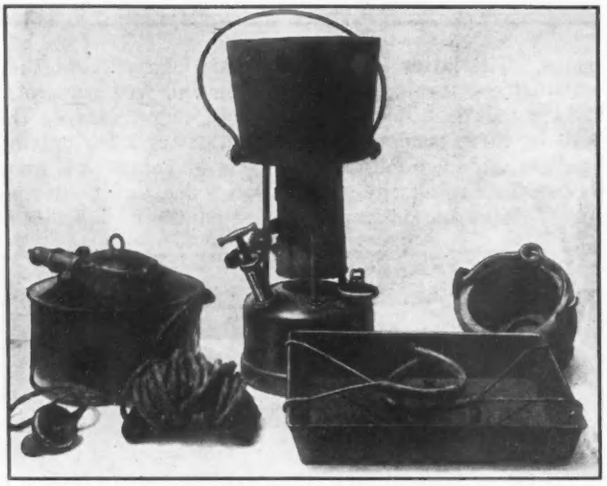


FIG. 3—COMPOUND KETTLE, FURNACE, SOLDER POT, TESTING DEVICE AND DRIP PAN

dle of the handle for fastening it to a safety hook when lowering or hoisting it with a line. When the kettle is set on the furnace the outer walls fit snugly around the upper part of the furnace. Enough space is provided in the upper compartment of the furnace so a solder pot may be set therein and heated while the compound kettle is being heated.

The solder pot embodies a new feature, that of having a tapered recess in the bottom which grips the solder when it is solid so it cannot be dropped out of the pot. The inward extending rim around the top of the pot prevents the solder slopping out when molten. A loop is provided in the bail, to which the safety hook can be fastened when raising or lowering the pot.

The exploring set is used for determining whether a cable is energized or not, preparatory to working on it. The device consists of a semi-circular iron core on which is wound numerous turns of fine wire, the ends of which are connected by flexible cord to a telephone receiver. When the core is laid over an energized alternating-current cable a buzz can be heard in the receiver. This device is also used for locating faults in conjunction with high frequency impulses sent out from a testing set at one end of the cable being investigated.

A Motor Trouble Traced to an Open Field Circuit in Controller

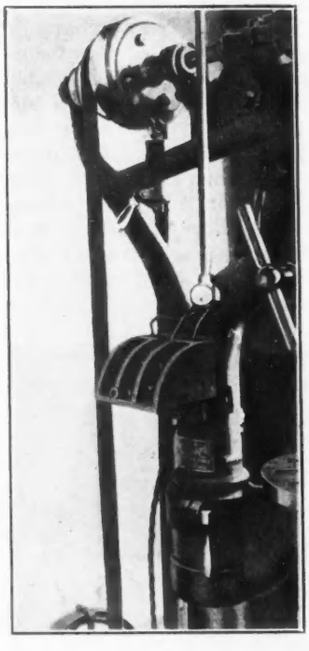
BY R. L. HERVEY

Recently an electric motor that had been working every day for approximately ten years suddenly started flashing at the commutator and blowing its fuses. The conditions first noticed was the grooved and pitted commutator. As the supply of fuses had been exhausted by the elevator operator, the repair man took the armature out to turn the commutator and repair the worn bearing on the pulley end. This bearing was of the rigid one-piece white-brass type. The motor had to be in operation by the following morning, and did not reach the repair shop until just before the regular evening closing time, so that the repair man wanted to make the quickest job possible. This was done by boring the bearing to about 0.25 in. diameter larger than the shaft and putting in a babbitt lining. In the hurry the bearing was not chucked exactly true while boring it to size, so that there was a binding of the shaft when the motor was reassembled. This was easily remedied by scraping the babbit.

After turning the commutator, the armature was tested for ground and short-circuit. It was found in good condition and the causes of the burning looked for elsewhere. This could be best done by trying the motor assembled with the belt off. To make the test, the repairman stood by the motor, one man at the main line switch with instructions to open the switch in case of any trouble, while a third man operated the elevator controller. As soon as the controller was turned to the running position the armature started off at an excessive speed and sparked badly. This action seemed to indicate an open shunt field circuit. An inspection was made, and the field wire from the controller to the motor was found broken close to the controller terminal and held so close to the terminal that it appeared to be continuous until given a pull. With the proper connection the trouble was removed.

Safeguarding a Machine Shop Motor Switch

When individual-drive motors are employed it is usually advisable to install the control switch within convenient reach of the operator. This is particularly true in machine shops, where the operators have to start and stop machines frequently, as otherwise considerable time will be wasted in non-productive movements.



PROTECTED SWITCH INSTALLED ON DRILL PRESS

In such places unprotected knife switches can hardly be used without exposing persons to unnecessary danger, however, because accidental contact is especially liable to be made therewith in handling loose pieces of metal. When price prohibits the use of inclosed switches, knife-switches may be used if suitably protected with guards. One method of doing this is shown herewith, the switch being mounted on a drill-press post. Access to each side of the switch is prevented by barriers screwed to the switch base while the front is guarded by two curved bars attached to cross braces. This arrangement allows connections to be made as usual and does not hinder the operation of the switch as the handle protrudes through the guard. Since the service circuits were installed on the ceiling, connections with the switch were run through a conduit drop, the lower end of which is equipped with a condulet. The illustration represents an installation in the Springfield (Mass.) central station company's service building where 440-volt alternating-current motors are used.

DISTRIBUTION DEPARTMENT STOCKROOM METHODS

How One Central Station Company Has Arranged to Issue Stock to Its Construction Men so They Will Not Be Delayed in Starting Work

Distribution foremen can avoid considerable confusion when "getting out" their linemen in the morning, and can complete more work in a given time, by storing and issuing stock systematically. How one central station company has equipped its storeroom and arranged for issuing stock after giving this matter serious consideration is outlined in what follows:

Working stock—that is, material which is required on practically all jobs—is stored on the stock-issuing floor adjacent to the wagon-loading platform and assistant line foreman's office. Bulkier and less-used materials are stored on other floors which are conveniently reached by elevator. Sheet-metal bins with removable shelves and partitions are employed to hold the smaller articles carried in the working stock. The bins are arranged back to back in rows which are two tiers high. As occasion arises to keep more stock partitions can be removed or additional tiers can be placed on top of those now installed and roller ladders employed to reach them. Each compartment is labeled with an embossed aluminum strip describing the contents of the bin and its number. Being held in grooves on the front of the bins, these labels can be easily replaced with others which can be made on a metal embossing machine installed in the building. Stock is stacked in the compartments so that the minimum amount of space is occupied and so inventories may be easily taken.

Wire cannot be conveniently stored in the bins, and hence reels containing the most-used sizes are supported on an inclined steel frame near the loading platform. In front of the reels is a vertical steel frame support-rollers over which the wire can be drawn in lengths suitable for any jobs. A measuring device which can be moved along the front of the frame is used to determine the amount of wire taken off any of the reels. Sometimes whole reels of wire are issued to the linemen when the amount of wire to be used is indefinite. The difference between the weight of the reel when issued and when returned indicates the amount to be charged to that particular construction gang. Although a platform weighing scale is installed in the stockroom, materials up to 1000 lb. in weight are generally weighed on a direct-reading machine which does not require setting of weights and therefore effectively prevents miscalculations.

Transformers, cable reels, etc., are stored in the basement. From 3500 kw. to 4000 kw. in transformers rated from 5 kw. to 150 kw. are kept in stock. The units are arranged in groups, the type, rating, etc., of which are indicated in black lettering on white panels suspended from the ceiling. The contents of cable reels are similarly indicated.

Along the ceiling of the basement is a trolley crane which can be used to transport heavy articles from place to place or to the elevator. For moving the larger transformers a new scheme is being developed. Each unit is provided with its individual wooden-frame platform. When the unit is to be moved a one-man truck will be employed, the platform being raised by a high-ratio lever and rolled along the floor.

To avoid the use of jacks when taking short lengths of cable off the reels stored in the building each reel will be supported on top of and between two rollers resting on a low platform. The rollers will be provided with bearings which will reduce friction to a minimum so that the cables can be easily revolved. With this equipment the reels can be placed close together, thereby saving space and facilitating the removal of cable.

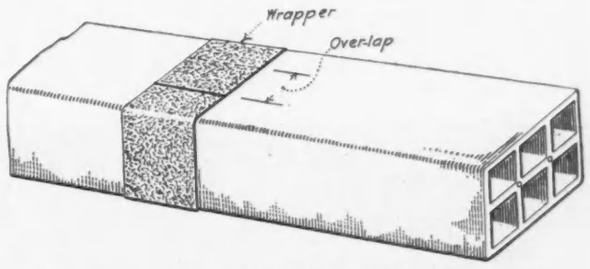
Spades, guy rods, metal cross-arms, tree molding, etc., are supported horizontally on metal racks made of angle irons. At present transformer oil is stored in the basement in the original tanks. It is the intention of the company, however, to provide means for drawing off oil on the loading platform. In the basement below a trap door in the loading platform is a metal bin for receiving scrap metal. This is sorted according to the material and stored in other metal bins until sold.

On an upper floor are stored lamps, fans, glass globes, carbons, etc. The lamps are left in the cartons, which are arranged according to the rating of the units they contain. Sheet-metal shelves resting on angle-iron frames are employed to support the glass globes, which are stored unwrapped and arranged side by side. Wire stock, street-lamp pedestals, insulators, wooden cross-arms, pins, etc., are stored on the top floor. The pins are kept in burlap sacks until used; cross-arms are stacked like lumber according to their size, and wire is stored on reels. Scrap wire as brought in from a job is piled in one corner of this floor. During rainy days when linemen cannot work they are employed to sort the wire, reeling up that which is serviceable and cutting up the rest for tie wires. The men are also employed to fit up cross-arms with pins, thus eliminating the need of special labor for such purposes.

Wrapping Tile-Duct Joints

BY C. A. DALRYMPLE

Since the joints of tile duct usually butt together and do not lap, some protection should be provided to prevent cement or obstructions of any kind getting into the duct. This is usually accomplished by wrapping the joints with burlap, muslin, cheese cloth or tar paper



TILE-DUCT JOINT COVERED WITH PLASTIC WRAPPER

and securing it in place with mortar. An eastern company however, is using a plastic wrapper which is both adhesive and water-proof. These properties make it more effective when applied, and being obtainable in any width the wrapper does not require as much cutting as the previously mentioned joint-covering materials.

The wrapper consists of a compound-treated twine base and comes on reels carrying 150 yd. Four stock widths—3 in., 3.5 in., 4 in., and 5 in. are made, but, other widths can be obtained if desired. For single ducts, 3 in. or 3.5 in. wrapper is advisable, for two, three and four-duct conduit, 4 in. wrapper, and for 6 and 9-duct lines 5-in. wrapper is recommended. To save time and expense in using the wrapper the night watchman can be instructed to cut it in the proper lengths for use the next morning. It is then applied to the joint as indicated in the accompanying sketch, being pulled tight and lapped over. The particular wrapper used by the company referred to is made by B. S. Barnard, 50 Church Street, New York.

COMMERCIAL AND BUSINESS POLICY

A Department of Plans and Methods for Widening the Application of Electricity and for Extending Electric Service

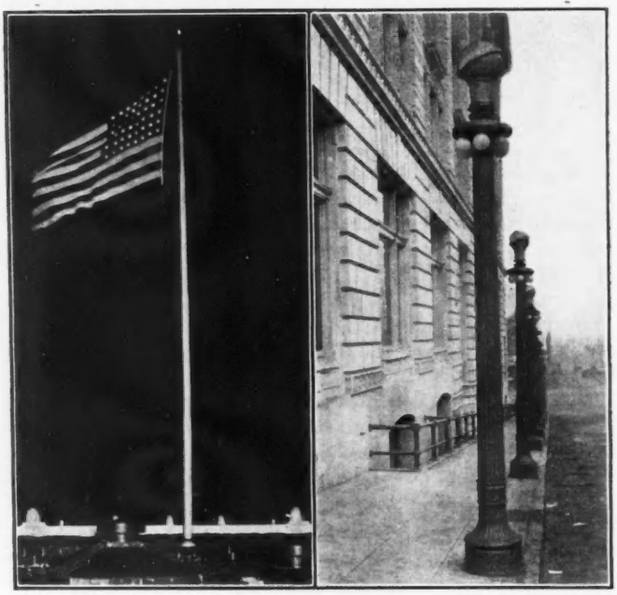
Curb Standards Employed for Close-Range Flood-Lighting of Building

A flood-lighting installation recently put in service in Seattle, Wash., involves the adaptation of street-lighting standards to a double use. In addition to carrying lamps for street lighting, each standard is surmounted by a tungsten lamp with a reflector adjusted to throw the rays upward, giving a flood-lighting effect on the building façade. The building on which this plan was put into effect is the new six-story structure of the Times Publishing Company at Stewart and Fourth Streets, Seattle.

On account of the narrow sidewalk the standards could be set with centers only 8 ft. from the building, but by inclining the reflectors upward at a sharp angle the desired effect was obtained. The standards, which are 15 ft. high, are the Union Metallic Standard Company's No. 1469 on which the usual 16-in. ball was replaced by a special mounting. The mounting designed especially for this service consists of a Pacific States Electric Company socket No. 622 with a BEL-500 reflector covered with a 16-in. clear glass hemisphere to exclude water and dust. The standards are spaced 20 ft. apart and twenty-five of them were required to light up all four sides of the rectagonal structure.

As first installed, the standards were equipped with a 1000-watt unit on top and six 25-watt clear glass Mazda lamps below. After trial it was considered better to substitute a 750-watt unit on top and six 50-watt Mazdas below. Additional lighting along the top of the building façade is secured by the use of 220 100-watt Type C Mazda lamps mounted behind frosted glass bowls under the coping of the structure. The building finish is of rose-colored terra-cotta.

THIS BUILDING IS FLOOD-LIGHTED FROM STANDARDS WHICH ALSO SUPPORT THE CURB ORNAMENTAL LAMPS



THE TOP OF THE BUILDING FACADE IS LIGHTED WITH 100-WATT TYPE C LAMPS. ALONG THE CURB 15-FT. STANDARDS CARRY THE COMBINATION OF STREET AND FLOOD-LAMPS

ELECTRICITY IN THE OIL FIELDS

Long-Hour Central Station Loads Offered by Well Pumping, Pipe-line Pumping and Oil Heating

"Up until the present year central station men in almost every oil field, except in California, have been 'asleep at the switch' as regards the possibilities of deriving revenue from oil-well business." In these words Charles A. Stanley, industrial engineer for the Kansas Gas & Electric Company of Wichita, expressed his viewpoint on the use of electricity in oil fields before the Kansas Public Service Association.

Two Kansas oil fields, the El Dorado and the Augusta fields, said Mr. Stanley, contain 950 producing wells. From these two fields alone the possible business for central stations has been estimated as follows:

	Wells	Hp.	Kw.-hr. Yearly
Deep-well pumping	600	15,000	1,500,000
Shallow-well pumping	350	500	100,000
Water pumping	...	500	1,000,000
Pipe-line pumping	...	1,000	2,000,000
Oil heating	...	2,000	1,000,000
Total	950	19,000	5,600,000

Well pumping operates at about 20 per cent load factor. Water pumping and pipe-line pumping, if properly installed, will give about 90 per cent load factor. The oil heating is necessary for about four months in the year, and then operates at about 60 per cent load factor.

Water pumping in the oil fields is very profitable

business. Each well requires about 150 bbl. of water daily during the process of drilling. For this service a pump is generally installed on the river bank and the water is pumped, in some cases, 6 or 7 miles to the leased area, where ten to twenty rigs may be drilling. The El Dorado field has seven water-pumping equipments operating electrically. One case is cited herewith to show the comparative cost of steam and electricity for this work. Two different lease owners had water-pumping equipments on the bank of the Walnut River with the pumps less than 50 ft. apart. One was a steam pump and boiler outfit using oil for fuel. The other was a centrifugal electrically operated set. The cost of operation per month follows:

STEAM EQUIPMENT

Investment, $1,400, 10 per cent depreciation	$11.70
Fuel oil at $1 per barrel	180.00
Labor at $3 per day	180.00
Total	$371.70

ELECTRIC EQUIPMENT

Investment, $450, 10 per cent depreciation	$3.80
Energy	71.00
Labor (starting and stopping)	7.50
Total	$82.30

At present the Kansas Gas & Electric Company has 103 hp. in water pumping in the El Dorado field. Some of the installations are very interesting. One motor is in the crotch of a tree 20 ft. above the pump, another is located on two poles 20 ft. above ground. This is necessary to get the motors above the high-water stage.

Pipe-line pumping is another very desirable business. Some of the installations pump against a head of 900 bbl., and inasmuch as the oil is being pumped from the field continuously the load factor is very good. But all of this business is difficult to get. It is sometimes difficult even to see that the business exists. For example, a certain engineer was sent into the El Dorado field last year to investigate and report on conditions. He reported practically no business obtainable, due to the fact that all oil wells produced a certain amount of casing head gas which was used in gas engines to handle all power requirements. Furthermore, he found nearly all the operators opposed to electric drive, due to their lack of experience in this particular line.

The opposition to electric drive by some of the operators is real opposition. A certain lease in the El Dorado field, for instance, was owned by a banker who had been persuaded to use motors. The superintendent of this lease, upon learning that motors were to be used, went to the banker's office and turned in his resignation, claiming that electric motors would not pump oil and he did not propose to be present to witness the entire failure of the field. But in California nearly every field along the power lines is operated electrically, and if electricity can be successfully used in California fields it can be sold in Kansas or in any other fields.

Better Lighting for Cincinnati's Big Stores

With warm weather, which is the open season for displacing gas arcs in Cincinnati, now past, the commercial department of the Union Gas & Electric Company is working on better store lighting. Salesmen in their territories are observing lighting conditions on customers' premises and are suggesting names to comprise a prospect list. A letter like the one at the top of the page is being sent to the list.

It is planned that the Mr. Thompson mentioned in the letter, who is a representative of a manufacturing company, will call upon merchants who are interested in improving their lighting and will talk "better lighting" in terms that the merchants can comprehend. It will not be his aim to sell goods. If the merchant is sufficiently interested to ask for specific suggestions for improvements, as it is expected he will be when he has heard what good lighting can accomplish, Mr. Thompson will agree to make a layout or draft suggestions to fit the case. Then, in co-operation with the sales department, a direct effort will be made to sell the merchant whatever he needs to make his store lighting efficient and effective.

Dec. 1, 1916.

Gentlemen:—

With a desire to render the best possible service to the merchants of Cincinnati, we beg to announce that we have secured, for a limited time only, the services of Mr. W. H. Thompson, a recognized expert on store lighting.

Our purpose is to offer the services of Mr. Thompson *without expense to you* to make suggestions or lay out complete plans for a better lighting system for your establishment.

You will agree that a well lighted store attracts trade. Good lighting costs no more than poor lighting. Mr. Thompson can assist you in improving the lighting of your store and we want you to feel free to call upon him for suggestions. As his services will, no doubt, be in great demand for the limited time he will be in Cincinnati, we suggest making an appointment. Phone Main 167.

Yours very truly,

THE UNION GAS & ELECTRIC COMPANY,
H. J. HOOVER,
Commercial Manager.

"Distinctive Service with Unfailing Courtesy"

The Rome (N. Y.) Gas, Electric Light & Power Company believes in training its employees to work with the public. It has had copies of the creed shown below attractively printed in two colors for distribution. The signature of the superintendent to all company announcements is a part of the company's policy to emphasize personality in its public relations.

ESSENTIALS
TO THE SUCCESS OF

THE ROME GAS, ELECTRIC LIGHT & POWER CO.

An Organization devoted to furnishing Distinctive Service with Unfailing Courtesy

The Same Being a Brief Code Evolved for the Benefit of Ourselves and Now Done Into Print for General Distribution at the Request of Our Many Friends—And for the Good of the Order

Absolute and Unfailing Good-Cheer on the Part of All Who Labor Here.

If You Can Not Learn to Live and Act This Part—We Can Not Keep You.

Strong Team Work.

"DISTINCTIVE SERVICE" Means a Star Team—Not a Team of Stars.

Rare Courtesy and Instant Alertness to the Wishes of All Whom We Are Privileged to Serve.

Willingness to Do the Menial Things as Well as the Highest Art.

The Ability to Keep Sweet Under All Circumstances.

The Faculty of Seeing, Anticipating and Efficiently Doing Those Unusual and Ofttimes Little Things that Mark This as

A PLACE OF DISTINCTIVE SERVICE

I Am Going to Live Up to This and—So Are the Rest of You.

Now in all kindness let me say: If the ideals are too high here for any one to grasp; why quietly leave us who are in a measure able to understand.

BERT MORTON,
Superintendent.

MAKING FRIENDS WITH CUSTOMERS IS AN IMPORTANT PART OF THE PUBLIC POLICY OF THE ROME GAS, ELECTRIC LIGHT & POWER COMPANY. THIS IS A SAMPLE OF ITS WORK ALONG THIS LINE

A MODEL "HOME ELECTRICAL" IN SYRACUSE BANK LOBBY

Nineteen Electrical Firms of Syracuse, N. Y., Co-operate to Set Up Six-Room Apartment in Local Leading Bank

A feature of America's Electrical Week as celebrated at Syracuse, N. Y., was the installation in the lobby of the First National Bank of a model apartment in cross-section, equipped electrically throughout. The electrical equipment started on the "front porch" with an illuminated house number, which also served as a porch light, and continued through to the electrical equipment of the laundry. This was a six-room apartment, consisting of living room, bedroom, bathroom, dining room, kitchen and laundry, each room being suitably furnished and decorated and equipped electrically.

"A point to be emphasized," points out M. O. Dellplain, chairman of the local committee which carried out this novel co-operative display, "is the fact that we have in this city a bank whose officials are of the progressive business type who appreciate the value of advertising and who are quick to see the advantages to be gained by having the local celebration of America's Electrical Week hooked up with their institution. They co-operated in every way possible, and joined in making the exhibit the great success which it was. The direct results of the celebration can only be estimated at the present time, but it is accepted as a fact that this exhibit has been the means of bringing to the minds of the public the great value of electrical appliances as Christmas presents to the housewife. It also produced results in showing to the small dealer the advantage of proper publicity and paid advertising. It has furthered the spirit of co-operation in the local electrical industry. It has been a fitting means of pyramiding the valuable results obtained locally through the celebration of Electrical Prosperity Week in 1915."

BANK ENCOURAGES HOME-INDUSTRY EXHIBITS

Particular attention is called to the novel conditions under which this exhibit was made, namely, the use of the lobby of the leading Syracuse bank. This bank has adopted the policy of allowing each Syracuse manufacturer to display his goods in its lobby for one week, thus acquainting the Syracuse public with what the industries of the city are doing.

The "Home Electrical" was a slight departure in this respect, inasmuch as it meant the use of the lobby for an exhibit in which retailers were mainly interested; however, the high character of the exhibit offset any objections which might have been taken, and everyone was satisfied that the exhibit during America's Electrical Week was a boost to both the exhibitors and to the bank. A measure of the feeling in this connection can be gathered from the fact that both the bank officials and exhibitors insisted that the exhibit was too good to take out at the end of the first week, so that it was continued through a second week during which it was inspected by many other visitors.

All This Week—Opening 8 o'clock Monday evening—and then every day from 10 A. M. to 10 P. M. in the Lobby of the First National Bank
The Home Electrical
The most interesting and instructive exhibit of how to make your home more convenient, more livable, more attractive, ever seen in Syracuse.
No Admission Charged
Six Rooms are completely equipped with all the electrical appliances and devices that make any home a place of joyous, healthful, convenient comfort. You will see here modern, inexpensive things electrical installed in
Living Room
Dining Room
Bed Room
Bath Room
Kitchen
Laundry
Syracuse Merchants Who Arranged and Financed The Home Electrical
Alexander F. Jones
Conduit-Miller Company, Inc.
Cronin & Nye
Crouse-Hinds Co.
Edward Joy Co.
Iako Refrigerating Unit
Krauss & Heil
Mohawk Electrical Supply Co.
Pass & Seymour, Inc.
Rogers & Hilton, Inc.
Syracuse Lighting Company
Syracuse Supply Company
Tuec Company of Syracuse
Come to this exhibit by all means. It is arranged and financed by the accompanying list of Syracuse Merchants for your entertainment and education. Come—and ask all the questions you please.

ONE OF THE NEWSPAPER ADS OF THE "HOME ELECTRICAL" IN THE BANK LOBBY

Nineteen local firms co-operated in the display, which was continued a second week in response to popular demand. Even the bank devoted its own advertising space to the subject of the electrical exhibit.

The committee in charge of the Syracuse celebration, besides Chairman Dellplain of the Syracuse Lighting Company, included J. W. Bryant, Jr., Wagner Electric Manufacturing Company; F. L. Huber, Mohawk Electrical Supply Company; Harvey N. Smith, Conduit-Miller Company, and Frank W. Driscoll, Pass & Seymour, Inc.

THE MODEL DINING ROOM AND KITCHEN OF THE "HOME ELECTRICAL" IN LOBBY OF SYRACUSE BANK

While completely finished on one side, these rooms on the other opened into the marble-lined bank lobby, the walls and central pedestals of which are visible in the pictures.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

INSULATING PROPERTIES OF TRANSFORMER OIL

Results of an Investigation Which Show the Predominant Importance of Keeping Insulating Oils Free from Dust

AN interesting experimental research on the electric insulating properties of transformer oil, carried out at the Electro-Technical Laboratory of the Imperial Department of Communication at Tokyo, Japan, is the subject of a pamphlet dated Aug. 30, 1916, and marked "Abstract of Report No. 25, of the Third Section, Electro-Technical Laboratory." The authors are Dr. T. Hirobe, W. Ogawa and S. Kubo. The oil tester consisted of a glass cylinder with a capacity of 25 cu. in., the two electrodes being adjustable so as to vary the gap and permit the removal of the electrodes for polishing and cleaning.

The chief result of the investigation is the predominant importance which any dust in the oil exerts on the insulating properties. The reason is that when a voltage is applied to the electrodes the dust particles will arrange themselves between the electrode ends so as to form a bridge. The importance of this became evident early in the investigation when it was found that the method of polishing the electrodes has a great effect on the breakdown voltage because by polishing with a cotton cloth one is liable to introduce cotton fibers into the oil.

All the tests showed that the dielectric strength of oil free from injurious dust or impurities is exceedingly high, the puncturing voltage being from 87 to 97 kilovolts per 150 mils between two sphere electrodes of 0.5 in. diameter, provided that the oil under question is of high quality. It is the injurious fibers bridging between the electrodes that impair seriously the insulating power of oil. These dust particles can be seen without any difficulty when looking through the gap before a strong light.

In order to clean the vessel and the electrodes without introducing dust into the oil, the authors have developed the following method which is quoted here verbatim: "Immerse the electrodes which are polished into oil in the containing vessel of the tester and adjust the gap as required. Apply a potential difference between the electrodes as high as possible for several minutes. The high-tension charge given thus on the electrodes is very effective to accumulate all the dust to the gap. Then wash the electrodes with the oil, take it out of the containing vessel, and after that, wash the vessel by stirring up the oil in it. This cleaning should, of course, be made with great care not to touch both the electrodes and the inner surface of the vessel. Now renew the oil in the vessel, put the electrodes in it as before, and then repeat the same operation several times. We can say that in an originary case the electrodes and the vessel become perfectly clean and free from dust if the cleaning process above mentioned is repeated at least three or four times successively and sufficient care is exercised."

The author next investigated the relation between the breakdown voltage and the length of the gap for different forms of electrodes. Either two spheres were used as electrodes, or a sphere against a disk, or two disks, or a needle against a disk. The lowest breakdown voltage was obtained with the needle and disk, as might be expected. But contrary to expectations the breakdown voltage between two disks is much lower than between two spheres.

The effect of the temperature of the oil on the dielectric strength was next investigated. The authors conclude that while the dielectric strength of oil is frequently said to increase with temperature, this increase is only apparent. It is not a true increase of the dielectric strength of oil proper, but is probably due to the fact that the hygroscopic substances such as cotton fibers, etc., contained in the oil are dried up by heating. "On the contrary, there are many reasons to believe

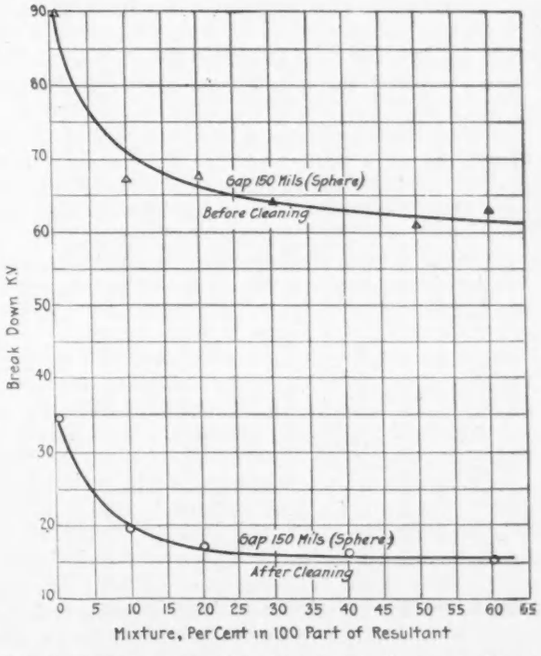


FIG. 1—BREAKDOWN KILOVOLTS OF NO. 1 OIL IN SPHERE ELECTRODES

that, provided the oil under test is absolutely clean and dry, its dielectric strength will decrease with the increase of temperature as stated by F. W. Peck, Jr., 1915, in his excellent paper."

The authors then discuss the effect of moisture in oil. The amount of moisture in the oil was determined by means of metallic sodium. Only a very small quantity of water can dissolve in oil, amounting to something like 1/100 of 1 per cent for transformer oil, and if an attempt is made to mix together an appreciable amount of water with oil a large part of water will always remain as emulsions or as many visible water particles finely divided into suspensions, which will agglomerate together sooner or later. The authors' results show that the water dissolved in the oil or the water particles suspended in the oil as emulsions have little effect on the disruptive voltage as long as the

oil is free from dust. But whenever any substances such as cotton fibers, which can easily absorb moisture, are present, they will easily be wetted by the water in the oil and the gap will soon be bridged. This is clearly shown in the curves of Fig. 1, in which the ordinates are breakdown voltages in kilovolts and the abscissas indicate the amount of moisture in the oil. The upper curve relates to dust-free oil, and shows that the effect of moisture on the breakdown voltage is relatively small. After this test was made the upper electrode was taken out and rubbed with a well-dried cotton cloth. This was sufficient to introduce enough dust into the oil to change the test results completely, as is shown in the lower curve. The breakdown voltage was thus greatly reduced.

From the final conclusions of the authors we quote the following: "While very small water particles have little effect in themselves on the breakdown strength of oil, particles of appreciable size, when resting on the high-tension coil of a transformer, have a very injurious effect in impairing the insulation. The filtering press is of practical value to filter the dust as well as the moisture, and the machine, therefore, should be fully cleaned before it is put in service. Let us consider the case where oil is in service in a high-tension transformer.

Whenever foreign substances exist in oil, they will be attracted to and accumulate on the high-tension coil, where the flux density is high. This, therefore, damages the insulation of the transformer seriously. It may then be positively stated that only a single fiber of poor insulating value will be sufficient to break the insulation of the transformer, however high the quality of oil may be as a whole, because the puncture occurs quite locally at the weakest point. In any case all possible care should be taken not to admit any dust, especially moist fibers, into the transformer, and it is advisable that in a large transformer house the oil should be circulated continuously through a filtering press to remove the dust as soon as it gets into oil."

Lamps and Lighting

Tungsten Lamp Manufacture.—Charles Eisler.—A surprisingly detailed description of the different successive steps and apparatus used in the manufacture of the tungsten lamp, with special reference to the "processes used by the United Incandescent Lamp Company, Budapest, Hungary." The article is illustrated by thirty-four drawings and describes in succession the manufacture of the tungsten filament from the slug, heating and swaging the slug, hot swaging the slug, drawing wires through diamond dies, cleaning and flashing the wire, forming the zigzag wire, cutting the glass tube, making the flange, making the lead-in wire, making the cane rod buttons, stem making, inserting the anchor, mounting the zigzag filament, operations on the bulb, piercing the bulb, tubulating the bulb, cracking off the collar, sealing the bulb, exhausting the lamp, basing the lamp, soldering the lead-in wires, inserting the hook end, bump testing.—*Machinery*, December, 1916.

Flame Arc in Chemical Manufacture.—W. R. Mott and C. W. Bedford.—One of the authors has found that the high-amperage white flame arc far excels all other sources of light for the purpose of accelerating the chlorination of natural gas in the manufacture of chloroform. This caused the authors to study in some detail the use of the flame arc for accelerating or bringing about chemical reactions and to compare it with the results obtained with other sources of light. The general results are as follows: The flame arc at high amperage is in proportion to the power taken, the most efficient known light source for photo-chemical reactions. A single flame lamp can easily be made ten to twenty times more powerful, as to chemical effect, than any other single lamp except possibly the high-amperage inclosed arc which at 25 amp. on 110 line volts is about one-third as powerful as the flame arc at the same amperage. The chemical action on solio paper by the light of the white flame arc through glass is nearly three times as powerful as that of the other colored flame carbons under like conditions. The chemical action on paraphenylenediamine (ultraviolet sensitive) by the light of the white flame arc light through glass is also three times as powerful as that of the other colored flame carbons. The white flame arc is the better suited for use with glass vessels which are cheaper than the quartz vessels. At high arc voltages the light and chemical power continue to increase as the arc voltage is raised; however, this is at a decreasing rate. A means of using an inclosed-arc lamp with flame carbons is described. This consists in using a shunt around the lamp resistance and solenoid on direct current or a reactance coil in shunt around the lamp reactance coil and solenoid on alternating current. Finally, there are opened up by the white flame arc many new possibilities for controlling and changing chemical reaction. The investigation was carried out in the research laboratory of the National Carbon Company.—*Journ. Ind. & Eng. Chem.*, November, 1916.

Generation, Transmission and Distribution

Substituting Paraffin for Petrol.—A device has been recently invented by F. A. Wilkinson of Hatfield, Herts, whereby motor cars and internal-combustion engines used for driving electric lighting plants and other purposes designed for running on petrol, can be run entirely on paraffin without alteration to the engine or carbureter. Wilkinson's "by-pass paraffin attachment" is inexpensive, and can be fitted up in a very short time, and the engine can be instantly converted to run on paraffin or petrol by simply opening or closing a valve. In order to vaporize the paraffin to enable a start to be made from cold, an electrical heater is provided which is wound for a suitable voltage, the power consumption being 196 watts for two and a half minutes. After the engine has started, the paraffin and air passing from the carbureter are heated by introducing a small percentage of the exhaust gases direct into the inlet pipe, which, mingling with the paraffin and air, enters the cylinders for a second time. The attachment has been fitted to stationary engines and the motor cars. When the attachment is fitted to a motor car, the two valves used are controlled from the dashboard by means of steel wires run in brass tubes, but in the case of a stationary engine the dashboard controls can be dispensed with. For controlling the electrical heater a switch and pilot lamp are provided, the second terminal being usually earthed when applied to a motor car.—London *Elec. Review*, Nov. 17, 1916.

British Power Station.—An article with map of the new power station of the Clyde Valley Electrical Power Company's new power station near Cambuslang. The first portion of the generating plant consists of one turbo-alternator of 5000 kw. output at 0.80 power factor, running at 1500 r.p.m. The turbine is of the Rateau type. Three-phase currents generated at 11,000 volts and 25 cycles are used.—London *Elec. Review*, Dec. 1, 1916.

Installations, Systems and Appliances

Coal-Loading Conveyors.—An illustrated description of several modern British electrically-driven coal-loading conveyors, one of which has a capacity of 700 tons an hour and another 200 tons an hour.—London *Electrician*, Nov. 24, 1916.

Electric Heating.—J. GUERNER.—A discussion of some industrial and commercial applications of electric heating.—*La Lumière Elec.*, Nov. 18, 1916.

Electrophysics and Magnetism

X-Ray Refraction.—DAVID L. WEBSTER and HARRY CLARK.—One of the best-known properties of X-rays, and the most important for their application to radiography is their ability to penetrate all known substances without being refracted. This has been verified by Roentgen and others, and was for a long time accepted as a good argument for the pulse theory in a form involving the assumption that atoms contain no oscillators whose natural frequencies are those of X-rays. Since we now know that this assumption is incorrect, the reason for the absence of refraction is not evident. Experimental work by several investigators has shown conclusively that rays of most frequencies are refracted very little, if at all. The appreciable refractive effect of a resonance frequency in optical spectra does not always extend far along the spectrum, however, and if this is true of X-rays, the refracted part of a heterogeneous beam might contain so small a part of the energy and be so widely dispersed as to escape detection. The present paper presents an analysis showing in what part of the spectrum the refraction, if it exists, ought to be greatest, and showing that under reasonable conditions this greatest value should be extremely small. It then describes experiments made to test the theory. Monochromatic rays were used in these experiments. No evidence of refraction was found.—*Phys. Rev.*, November, 1916.

Comparison of Alternating and Direct-Spark Potentials.—J. C. JENSEN.—An account of an experimental investigation in which alternating and direct-spark potentials were measured under exactly the same conditions—the gas, electrodes, and pressure being identical throughout. It was found that the effect of illumination by ultra-violet light of a gap supplied with alternating potential is essentially the same as that observed by Warburg for direct potential; and, in addition, that the presence of an abundance of ions lessens the irregular influence of transient voltages due to static and resonance phenomena. The time interval during which the alternating potential must be above that necessary to produce a spark by direct potential was found to be practically the same for all conditions as regards gases, electrodes, and pressures, the alternating maximum potential always lying above the corresponding direct one. An attempt to reproduce evidence that, with an increase of current density of discharge, there is a corresponding decrease of spark potential, gave negative results, all indications tending to show that such an effect must undoubtedly be caused by resonance in the discharge circuit.—*Phys. Rev.*, November, 1916.

Electrochemistry and Batteries

Electrical Precipitation.—R. W. KERNS.—An illustrated article on the Cottrell process of electrical precipitation of dust from smelter fume. A general description of the principle of the process is given; it is to apply a unidirectional potential of 25,000 to 250,000 volts to a tube through which the gas is passing and thereby charge the particles in the gas and cause them to be deposited on the inner side of the tube. The author mentions various industrial installations, and describes especially the installation at Miami. Two precipitation plants are installed at this smelter, one of which treats the gases from the roasting or drying furnaces and the other treats the converter flue gases. In order to obtain a unidirectional current at from 60,000 to 100,000 volts, a rotary switch is used to rectify the current of a high-potential transformer. Two arms carrying a segment of copper plate at each end are mounted on a shaft at right angles to each other, as in Fig. 2. The arms are insulated from the shaft and from each other, and revolve between the adjustable brushes, which clear the plates by a half inch. Electrical synchronism is obtained by driving an alternating-

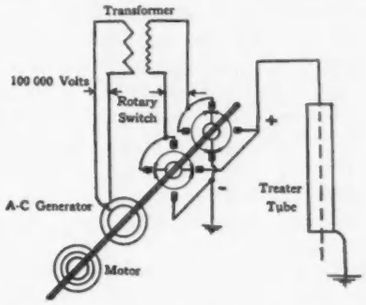


FIG. 2—ELECTRICAL CONNECTIONS OF APPARATUS

current generator directly connected to the switch. This generator furnishes the primary current of the transformer as well as the means of voltage control by variation of the field resistance. The generators and transformers each have a rated capacity of 15 kva. There are eight of these electrical sets operating at about two-thirds of their rated capacity, besides two units which are held in reserve. This means a power consumption of 16 watt-seconds per cubic foot of gas treated.—*Elec. Journal*, December, 1916.

Units, Measurements and Instruments

Temperature Measurements by Thermocouples.—E. F. KINGBURY.—A note on an investigation carried out in the physical laboratory of the United Gas Improvement Company of Philadelphia. During the investigation of the temperatures assumed in a flame by mantles of various compositions, the author has made extensive use of Heraeus platinum-platinum-rhodium couples of four different sizes. As is well known, when these are placed against the mantle they will assume different temperatures, depending upon their size, and when their diameters are plotted against the temperatures as abscissas a continuous curve concave upward is obtained which, when extended to zero diameter, gives a limiting temperature to the mantle wall. Consistent results have been obtained yielding many smooth curves. An explanation of the shape of these curves has been sought, assuming the couple and mantle surrounded by a film of gas through which the heat is conducted. An expression has been obtained that gives the shapes of these curves as obtained experimentally. It has been of assistance in showing the shape of the curves from zero to the smallest diameter. The theory has also been extended to cover the temperatures assumed by mantles of various emissive powers when placed in a flame of known temperature. Here it has been assumed that the mantle is heated in much the same manner, except that outside the mantle the flame has been cooled in many cases at least nearly to the mantle temperature. This wall of flame protects the mantle from convected and conducted heat losses. The radiation efficiency calculated for the higher temperature mantles agrees with that actually measured experimentally. It has been found that the total emission per unit area per steradian is nearly a linear duction of the temperature assumed in a flame. The theory in the light of the experimental curve is interesting as helping to explain the mechanism of a flame heating a mantle placed in it.—*Journal Franklin Inst.*, October, 1916.

Book Reviews

HOW TO BUILD UP FURNACE EFFICIENCY.—By Joseph W. Hays. Published by the author at Chicago, Ill. 154 pages. Price $1.

In this book, which is the tenth edition, the author treats the rather technical subject of combustion in a popular way. The narrative style of writing has been followed and anecdotes have been used liberally throughout the book. Human interest references have been made where possible to sustain the reader's interest. Very little is said in the book relating to the theory of combustion, the book being devoted to why, how, and where fuel is wasted in the boiler-room. Charts, diagrams and illustrations are used to bring out points hard to explain in text.

HOW TO MAKE LOW-PRESSURE TRANSFORMERS. Third edition. By Prof. F. E. Austin. Published by the author at Hanover, N. H. Price, 40 cents.

To the third edition of this little book has been added instructions on a new and very simple form of core construction; how to make a transformer without the use of disks for a core and a novel utilization of tin cans as transformer cores. These additions are written clearly and satisfactory results should be obtained on following the instructions given. The book contains a great deal of practical information not found in usual texts on transformer construction and operation. It will be found of value to experimenters and repair men.

HYDRAULICS. By R. L. Daugherty. New York: McGraw-Hill Company, Inc. 268 pages. 243 illustrations. Price, $2.50.

This book has been prepared as a college textbook for students who are evidently not required to go into the subject of hydraulics very extensively. As such a text it appears to have been carefully worked out and covers the principles of hydroelectric engineering as well as could be expected in a text of 264 pages, many of which have diagrams and half-tone illustrations. The last 100 pages of the book take up in a rather practical way the construction and operation of different designs of turbines and centrifugal pumps. A good idea of the nature of the material presented can be secured from the following chapter headings: Intensity of pressures; hydrostatic pressure on areas; applications of hydrostatics; hydrokinetics; applications of hydrokinetics; flow through pipes; uniform flow through open channels; hydrodynamics; the impulse wheel; the reaction turbine; water power plants; theory of the impulse wheel; theory of the reaction turbine; turbine laws and factors; the centrifugal pump; and tables and data. The work is a serious attempt to abbreviate a very extensive and complicated subject, and from this standpoint it is well done.

EXAMPLES IN ALTERNATING-CURRENTS. Vol. I. By Prof. F. E. Austin. Published by the author at Hanover, N. H. 224 pages. 70 illustrations. Price, $2.40.

This book is especially adapted to guiding students of alternating-current calculations since it presents steps in the application of abstract theory to concrete problems. While it is primarily suited to this purpose it may also be used as a reference book by practical engineers who do not care to burden their memories with formulas. In the first part of the book are given such geometrical and trigonometrical relations as are constantly used in alternating-current calculations. Calculus is used quite extensively throughout the book, the author stating in the preface that no apology need be offered since its use saves considerable time in the solution of many problems. In addition to numerous examples showing the method of calculating generated voltages and correcting for wave form, many problems are worked out both mathematically and graphically involving inductances, capacitances and resistances in various combinations. Tables are included giving the reciprocals of capacitances, values of capacitances and inductances required for resonance, and values of functions involving π.

APPLIED ELECTRICITY FOR PRACTICAL MEN. By Arthur J. Rowland. New York: McGraw-Hill Book Company, Inc. 376 pages. 323 illustrations. Price, $2.

This volume has been written as a text book for teaching fundamentals of electricity to practical workers; to men who expect to make direct application of the principles given them in the class room to their daily work with commercial circuits and electrical machinery. It appears to be written wholly from the standpoint of one who puts up and operates electrical circuits and apparatus. Theory is avoided, except in instances where it has direct bearing upon practical matters. The principles stated and the explanations of apparatus which are offered are only such as are necessary in order to present essential elements. A set of problems is found at the end of each chapter to make clear the principles set forth in the chapter. On the whole, these problems are well chosen and will assist the student to understand how the apparatus works. The book is clearly written and will be understood by the practical man with an average education. There are many working diagrams of the apparatus described, as well as illustrations of modern apparatus made by electrical machinery manufacturers. The twenty-three chapters of the book cover fundamental principles, electrostatics, direct and alternating-current principles, machines and applications, storage batteries, lighting, wiring, electric heating and electric power.

ELECTRIC SWITCH AND CONTROLLING GEAR. By Charles C. Garrard, Ph.D. London, England: "The Electrician" Printing & Publishing Company, Ltd. 656 pages. 433 illustrations. Price 15 shillings, net.

This book presents a classification of electrical switch and controlling gear, and formulates the principles underlying design and construction. The author has treated each individual theory or construction, as far as possible, by itself. In the reviewer's mind, this method of treating electrical switchgear, a subject which easily allows itself to be treated in a very complex manner, makes the treatment as simple as is consistent with accuracy and thoroughness. The author has given considerable attention to the standardization of switch and controlling gear, a number of comparisons being made with the standardization work already accomplished in other countries. A feature of the text is the large number of well-arranged and clear illustrations and drawings.

The subjects treated and appearing as chapter headings are as follows: Materials and manufacturing methods, apparatus for making and breaking electric circuits, apparatus for preventing a dangerous condition of the current flowing, apparatus for regulating the amount of current, apparatus for starting and controlling electrical running machinery, low and medium-tension switchboards, high-tension and extra-high-tension switchboards, apparatus for protecting electrical machinery against abnormal electrical conditions.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

R. B. Marchant, who has been treasurer of J. G. White & Company, Inc., New York City, has been elected vice-president of the company.

Gerrold G. Brown, assistant general manager of the Ithaca (N. Y.) Gas & Electric Corporation, has severed his connection with the company.

J. H. Giles of Gloucester, Mass., has been appointed superintendent of the lines of the Worcester Suburban Electric Company of Uxbridge, Mass.

H. C. Brown is now manager of the Edwin Joy Electric Company at Syracuse, N. Y. For a number of years Mr. Brown has been Canadian representative of the Crouse Hinds Company.

D. M. Debard of the Edison Electric Illuminating Company of Brockton, Mass., has been appointed president of the New England Central Power Salesmen's Association, which was recently organized in Boston, Mass.

P. I. Robinson, assistant superintendent of the Houghton County Electric Light Company, Houghton, Mich., in charge of the Calumet division, has been appointed superintendent of the Houghton division of the company.

Linn W. Bennett, for many years superintendent of construction for the electrical department of the Ithaca (N. Y.) Gas & Electric Company, has resigned. Mr. Bennett, it is understood, will enter business for himself in Ithaca.

Otto Snyder, for the past four years superintendent of the Houghton County Electric Light Company, Houghton, Mich., has resigned to accept a position with the Adirondack Electric Power Corporation of Glens Falls. Mr. Snyder will be connected with the power sales department of the Adirondack company.

Walter Belding, electrical superintendent of the Rutland (Vt.) Railway, Light & Power Company, has resigned to accept the position of manager of the municipal electric-light plant in Burlington, Vt., succeeding L. R. MacBroom. Mr. Belding has been associated with the Rutland company for four years. He was graduated from the University of Vermont in 1911.

J. F. Killeen, who has been manager of heating-device sales of the General Electric Company at its Pittsfield, Mass., plant, will, on Jan. 1, assume the position of vice-president and sales manager of the Rathbone, Sard Electric Company of Albany, N. Y. For nearly ten years Mr. Killeen has been active in the heating-device business, in the development of this branch of the General Electric Company production.

B. J. Grigsby, who has been managing director of the Benjamin Electric, Ltd., Rosebery Avenue, London, E. C., England, since its incorporation in 1908, has resigned his position with that company and returned to the United States. Mr. Grigsby intends to locate a factory in Peoria, Ill., for the manufacture of porcelain-enamel products and electric-lighting specialties. His temporary address is 24 Mayer Building, Peoria.

J. J. Donohue has been appointed chief operating engineer of the Boston (Mass.) Elevated Railway.

W. A. Shoudy, formerly of the apparatus department of the Brooklyn Edison Company, has joined the engineering staff of the J. G. White Engineering Corporation, New York City.

A. C. Blinn, who has been president, treasurer and general manager of the Evansville Public Service Company, has been appointed in charge of the Northern Ohio Traction & Light Company, with headquarters at Akron, Ohio.

Cyrus Corliss, for the past eleven years assistant to the chief engineer of motive power and rolling stock, Boston (Mass.) Elevated Railway, has been appointed construction engineer of the department of power. Mr. Corliss entered the company's service in 1900, after taking a special course in electricity at the Massachusetts Institute of Technology, and reached the post of assistant to the electrical engineer before being transferred to the office above named.

H. O. Clare, the president-elect of the Electrical Credit Association of Chicago, has just completed his twenty-fifth year in the employ of the General Electric Company. Mr. Clare started in the electrical business with the Brush Electric Company of Cleveland, Ohio, in 1891. Later, when that company was absorbed by the General Electric Company, Mr. Clare was retained. Since that time he has served in various positions for the company at Schenectady, Atlanta, Madison and Chicago. During the last eight years he has been in the company's Chicago office, where he now holds the position of district auditor, and is in charge of the credits, collections and accounting for that district.

H. O. CLARE

J. G. Barrett, formerly of the Ivanhoe Regent Works of the General Electric Company, has joined the staff of the Texas Power & Light Company at Dallas, Tex., to become the head of its lighting department, a newly organized division under the supervision of the commercial manager of the company. Mr. Barrett will have charge of all illumination work in the one hundred towns and cities where the company operates electric properties. A vigorous campaign for commercial and residential lighting will be prosecuted.

Paul Lüpke, who for many years has been superintendent of the southern division of the Public Service Electric Company at Trenton, N. J., will, in his new work at its Newark headquarters, have charge of the extensive library of the three companies which make up the Public Service Corporation of New Jersey. Mr. Lüpke was for several years editor of the N. E. L. A. Question Box, and his annual papers, filled with shrewd philosophy of men and methods, have been features of N. E. L. A. conventions. Through an error last week it was stated Mr. Lüpke would continue in operating work. He has, however, been relieved from active operating responsibilities in order to devote himself to broader usefulness in the organization, along lines for which he is peculiarly well fitted.

Obituary

E. J. Mock, president of the Electricity Magazine Corporation, Chicago, publisher of the *Telephone Engineer* and *Electric Vehicles,* died on Dec. 18, following an illness of several months.

James Y. Carithers, president of the Athens (Ga.) Railway & Electric Company, died on Sunday, Dec. 17, at the age of sixty-two, from heart disease. At the funeral the employees of the Athens company acted as pallbearers, and the interment took place at Mr. Carithers's old home.

Col. George M. Rossman, treasurer and manager of the Keene (N. H.) Gas & Electric Company, treasurer of the Laconia (N. H.) Gas & Electric Light Company and of the Ashuelot (N. H.) Gas & Electric Company, died on Dec. 10 at Keene, aged forty-five years. Colonel Rossman was widely known in the New England public utility field.

Hon. Clarke C. Fitts, counsel of the New England Power Company, died at Watertown, Mass., on Dec. 20. Mr. Fitts was born in West Wardsboro, Vt., in 1870, and for several years was attorney-general of Vermont. With headquarters at Brattleboro, Mr. Fitts was closely associated with the pioneer development of the Connecticut River Transmission Company and related hydroelectric systems under Chace & Harriman, Inc., of Boston. He was a magnetic and enthusiastic speaker, and only recently addressed the New England Street Railway Club on the future of water power, in which he predicted the near approach of steam-railroad electrification from hydroelectric plants in northern New England.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Electric Welding System

For use with the electric welding system developed by the Wilson Welder and Metals Company, Inc., Vanderbilt Concourse, New York City, two motor generator sets are made. One type consists of a squirrel cage induction motor and a 35-volt, direct-current, compound

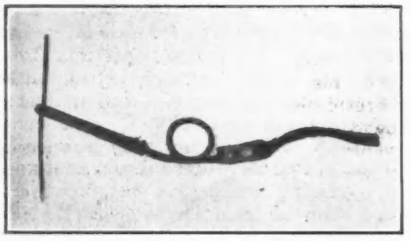


FIG. 1—WELDING TOOL OR ELECTRODE HOLDER FOR DISTANT CONTROL SWITCH

wound, interpole generator, and the other of an interpole, direct-current motor and 35-volt, direct-current compound wound, interpole generator, mounted on a heavy cast-iron sub-base and provided with self-oiling bearings lined with hard babbitt. Portable equipments are also made. The rotors of both machines of both types are mounted on a single shaft of high carbon steel supported on two, three or four bearings, and the bearing housing of the set is a demountable type so as to permit easy removal of the rotors. The compensators are equipped with a no-voltage release.

The general function of the constant current control panel (Fig. 2) for welding and cutting is to maintain a constant flow of current between the welding tool and the material operated on, regardless of variations in the resistance of the welding circuit, due to varying lengths of arc, or other causes. The current regulator consists of a carbon pile held under compression by one or more helical springs, the pull of which is opposed by a solenoid through which the current to be regulated is passed. The springs are mounted on a carriage in such a manner that it is possible to vary the point at which they act upon the lever of the carbon pile, which lever is connected to the control solenoid. This makes it possible to increase or decrease the leverage, the position of the control solenoid with regard to the lever being fixed. The movement of the spring carriage described above is produced by a small electric motor, so wired that it may be controlled by two push buttons located at the welding tool, or near enough to the welding tool so that the welding operator can use them without changing his position. The panel is also provided with a reactance coil of a size sufficient to materially assist the operator in maintaining an arc with a graphite pencil when the panel is used for "cutting" or burning away metal in preparing for the welding process, or other purposes. An ammeter is provided to indicate the amount of current used in the welding process, and a double throw switch of 200 amp. capacity, for use in changing from the welding circuit to the cutting circuit.

While the welding operator maintains an arc between his welding tool and the work, the control panel must maintain the current constant within 5 per cent of the mean value, regardless of the actual value of current that is flowing, provided the flow is between the limits of 80 and 175 amp., which is the range of current.

A specially prepared welding metal in the form of an electrode is provided. This is composed of a homogeneous

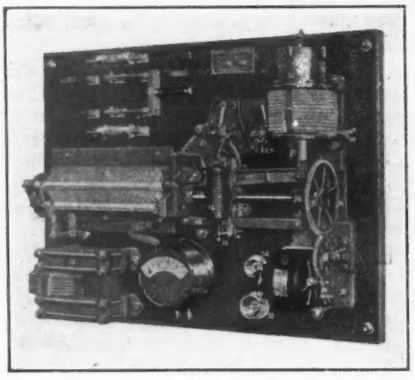


FIG. 2—CONSTANT CURRENT CONTROL PANEL FOR WELDING AND CUTTING

alloy combined with such excess of manganese as will compensate for losses while passing through the electric arc, securing a substantial amount of manganese in the welded joint, which is essential to its toughness.

Pole-Top Transformer Switch

Simplicity of design and operation, ruggedness of construction and low cost of installation have been the chief aims of the maker, it is pointed out, in the design of the transformer switch for pole-top service shown here. This type of switch is made for voltages from 2300 to 33,000. Separate dead-ends are necessary for switches up to 4500 volts, but the higher voltage equipment is designed so as to permit the dead-ending of the line wires directly on the insulators of the switch, thus giving a minimum number of parts. Attention is called to the mounting and control of these switches. While the three legs of the circuit are opened and closed simultaneously by means of the rear control rod, each pole of the switch is separate from the others and is absolutely self-contained. The channel baseplate and the channel arm supporting the insulators are riveted together, and no amount of warping of the crossarm, it is claimed, can throw the switch arms out of alignment. No extra crossarms are required, as the regular line crossarm is used to support the switch.

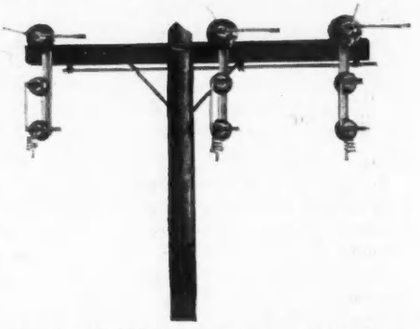


FIG. 1—17,000 VOLT FUSED TRANSFORMER SWITCH, OPEN

These switches are built of structural iron, fabricated, and then hot-dip galvanized. No clamps are used on the insulators, cemented caps being employed. The units are assembled when shipped from the factory, and to install them it is only necessary to bolt the three units to the crossarm and attach the line wires and control rods. Choke coils and spark gaps are advised by the makers in sections of the country

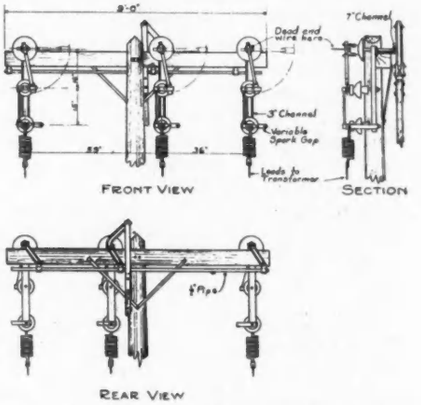


FIG. 2—DETAILS OF POLE-TOP SWITCH

where difficulties with lightning are experienced. The choke coils furnished consist of a stiff galvanized iron coil. The iron is of ample carrying capacity for the switch and gives additional impedance against the lightning charge.

As the gap arcs over, due to a lightning charge, the fuses are blown and the line is cleared. The spark gap is adjustable by means of a screw attached to an arm brought up from the base of the switch. The K.P.F. electric Company, 37 Stevenson Street, San Francisco, Cal., is the maker of these switches.

Indicating and Recording Demand Meters

The indicating and graphically recording types of demand meters shown here and now made by the General Electric Company of Schenectady, N. Y., operate on the same general principle and are furnished for use with either alternating-current or direct-current watt-hour meters.

The two essential parts of these meters are demand registering and timing mechanisms connected and mounted in the same case. The demand registering element, for all types, is electrically driven from the register of the watt-hour meter in which is mounted a contact device. The contact device consists of a small contact-making cam, of insulating material, and two parallel leaf-springs, equipped with platinum iridium contact points. Rotation of the cam by the watt-hour meter closes the circuit through the electro-magnet coil of the indicator and operates the registering mechanism as described below.

When the contact device closes the circuit through the magnet coils of the demand meter, the armature of the electro magnet is attracted and moves forward engaging the pawl at its end with the ratchet wheel, turning the latter. When the contact device opens the circuit a spring returns the armature lever and pawl to their original positions. The motion of the ratchet wheel is transmitted through gearing to the stylus, or the pointer, as the case may be, moving it forward for each closing of the circuit until the end of the time interval is reached. At this point a cam driven by the timing element has rotated to such a position that a trip lever disengages a sliding pinion from the gear with which it meshes thus opening the gear train and allowing a spring to return the stylus or pointer advancing mechanism to the zero position. Further rotation of the cam returns the sliding pinion to its former position and re-establishes the gear train. The mechanism is now in a position to measure the energy consumption during the next time interval.

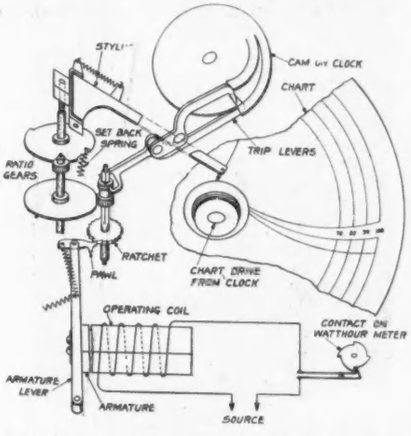


FIG. 1—MECHANISM FOR RECORDING TYPE OF DEMAND METER

The indicating type demand meters are made for direct and alternating current. The alternating current meter device utilizes a constant speed motor for the timing element and the direct current meter uses a standard make of eight-day clock movement. The recording type is made in one form and contains an eight-day clock movement for the timing device whether used on alternating current or direct current. In the operating mechanism, the indicating meter differs from the recording meter in the return mechanism operating at the end of each interval. With the indicating type it is not necessary to keep absolute time, and the mechanism is simplified on this account leaving a short interval of time between each measurement.

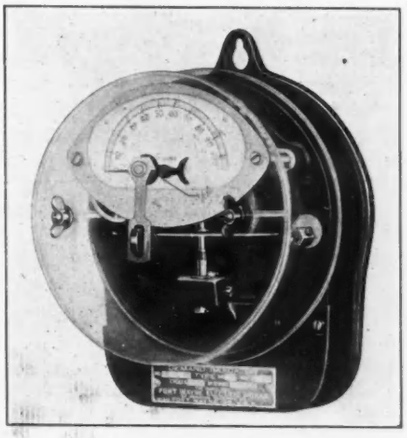


FIG. 2—EXTERIOR VIEW OF INDICATING DEMAND METER

In the graphic device the timing mechanism needs attention only when the paper is renewed and a time-setting disk is provided to synchronize the chart with the correct time. These charts are arranged to cover one week and the divisions show the current consumption hour by hour and day by day, during that period. The record takes the form of a saw tooth polar curve and the distance of the extreme points of the curve from the zero lines of the chart indicates the demand in kilowatts.

All types of recording meter are made for 6, 18, 110 or 220-volts capacity, direct current, and for 25 or 60 cycles alternating current, 110 or 220 volts. The time interval is fifteen, thirty or sixty minutes as specified. For operation on 440-volt alternating-current circuits a small transformer can be furnished to transform to 110 volts 25 or 60 cycles. The indicating types are self-contained and for operation on 110 or 220-volt circuits, direct current or alternating current, 25 or 60 cycles. The time intervals are the same as for the recording type. For operation on 440 and 600 volts alternating current a transformer is provided. On direct-current voltages above 220, all types must be operated from a battery circuit.

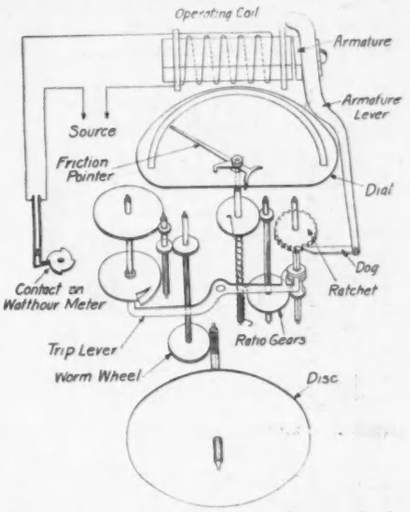


FIG. 3—MECHANISM FOR INDICATING TYPE OF DEMAND METER

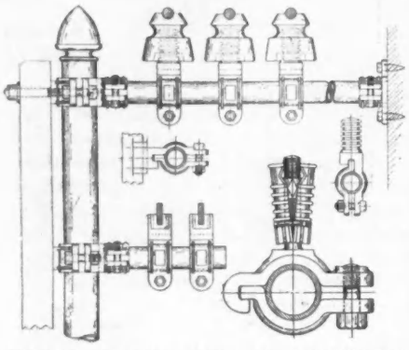
Lamp Dimmer

An improved form of individual lamp dimmer has been placed on the market by the Anylite Electric Regulator Company of Fort Wayne, Ind. It derives its trade name, "Anylite," from the fact that it can be used to give varying degrees of light with any Edison medium-base incandescent lamp of less than 60-watts rating, regardless of whether the lamp has a carbon or metal filament. The accompanying illustration shows the device, which consists of a combined plug and socket with a series resistance and a rolling contact actuated by means of a beaded brass chain. The chain has a draw of 2.25 in. The device is fitted with an air chamber to prevent it from overheating. The "Anylite" regulator has been approved by the National Board of Fire Underwriters. A. Hall Berry, New York, is Eastern representative, and Bailey-Drake & Company, San Francisco, Cal., representative in the West.

INDIVIDUAL LAMP DIMMER

Threadless Pipe Clamps

Clamps that not only afford a saving in labor, but also provide an adjustment not obtainable where threads are used, are the claims made by the Selah Manufacturing Company of Newark, N. J., for its threadless pipe, clamps and holders. Attention is also called to the fact that the method employed in the design provides a tremendous grip with only a slight tension on the bolts, due to the leverage of the fittings. Each clamp is ready to install when received, all fittings being shipped complete, with the necessary bolts and nuts. The large illustration shows a secure and unique method of erecting a switchboard and securing it to the wall. It also shows methods of supporting busbars and pin-type insulators. In the lower right-hand corner is shown a clamp used with expansion bolt shields for supporting pipes and cables to brick or concrete walls.



SPECIAL CLAMPS USED IN INSTALLING PIPE FRAMES

Safety Coils for Series Alternating-Current Circuits

The coils shown in the accompanying illustrations are now being made by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., for use where the voltage of series arc or incandescent alternating-current circuits is too high to permit the safe installation of lamps. These coils are for indoor and outdoor service and are especially useful on series street circuits where numerous trees would result in trouble from grounds; on bridges and in subways where the high voltage of the regular series circuit is prohibitive, or for lighting fire-alarm, police, and letter boxes, where high voltages so near the ground would prove dangerous. They are intended for use where but a few lamps are required in a building and a multiple circuit is not available.

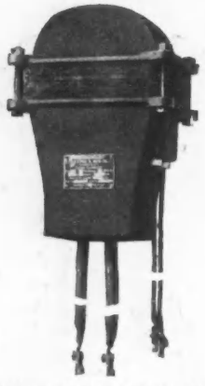


FIG. 1—SAFETY COILS FOR CIRCUITS OF LIGHT LOAD

The coils are essentially one-to-one ratio series transformers insulated for high potentials, being tested for 20,000 volts for one minute between windings and between windings and iron. The smaller capacities of these coils are built for air cooling, and are of the same form of construction as the standard Westinghouse dry type current transformers. The magnetic circuit, having laminations exposed to the air, is clamped between cast-iron end caps which protect the windings, the leads extending downward through suitable bushings in the bottom end-cap. The coils are impregnated with an insulating compound which thoroughly seals up the joints between the laminations and the end-caps. The larger capacities are oil insulated and are of the same form of construction as the oil-insulated distributing transformers made by the same company.

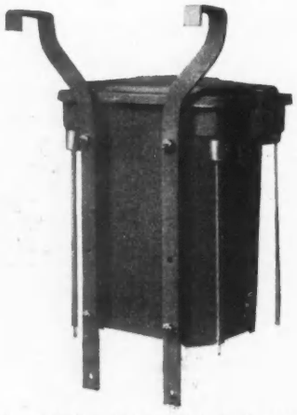
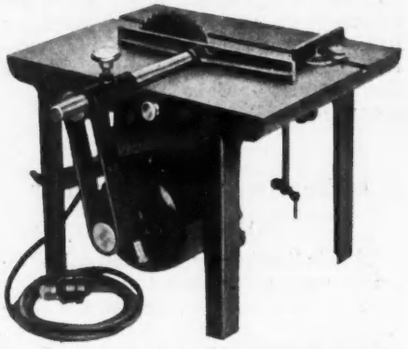


FIG. 2—OIL-INSULATED SAFETY COIL FOR HEAVY LOADED CIRCUITS

Motor-Driven Saw Table

A handy, portable motor-driven saw table that is rugged in construction is being marketed by James G. Biddle, 1211-1213 Arch Street, Philadelphia, Pa. With the proper saws, this device will cut hardwood up to 1 in. or 1.5 in. thick, soft wood from 1.5 to 2 in., and brass or fiber up to 0.5 in. thick. By rotating when sawing, brass or fiber tubing with walls up to 0.25 in. thickness, it is claimed, can be easily handled, as well as rods of the same materials up to 1.5 in. in diameter.

The framework of the table is one casting, providing a rigid support which is planed smooth and true, with all parts carefully fitted. For grooving or slotting, the table top may be raised or lowered by means of an adjusting screw. As shown in the illustration, the motor and switch are protected by mounting on the under side of the dust chute. This chute is hinged at one end, the other end resting on an adjusting screw. By this arrangement, the tension of the belt is easily regulated. The table is 12 in. by 16 in. and 12 in. high. The maximum diameter of the saw is 6 in.; and the weight of the outfit 65 lb. The motor is of special design, 110 or 220 volt, alternating or direct current.

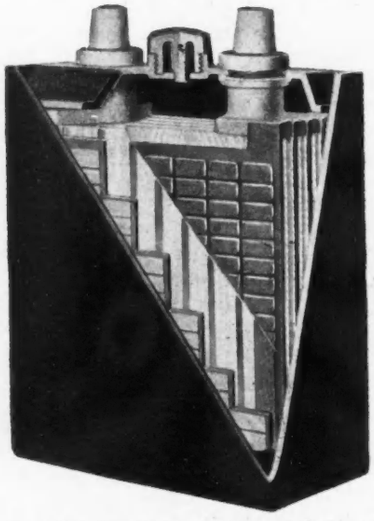


PORTABLE SAW TABLE (MOTOR DRIVEN)

Automobile Battery

An automobile starting and lighting battery for which the makers claim a high starting ability is shown here. Each cell is a separate, sealed unit with inter-cell connectors which, when removed, permit any cell to be taken from the case. The cells are closed at the top by covers having suitable sealing flanges. Only a small amount of sealing compound is necessary to form, with the cover, a tight and strong closure for the cells, yet one that can be readily opened for inspection or repair when necessary. The space formerly devoted to bulky sealing compound is used in these batteries to obtain greater plate area. It is claimed that this increase amounts to about 20 per cent as compared with that in many batteries of the old construction. This large plate area permits overcharging with minimum heating and wear on the plates.

The Cincinnati Storage Battery Company, 228-230 Stark Street, Cincinnati, Ohio, is the manufacturer of these batteries.



SEPARATE SEALED CELL FOR AUTOMOBILE BATTERIES

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Public Service Commission News

Idaho Commission

The Public Utilities Commission and the act creating and clothing it with power are under fire in Idaho. There appears to be a concerted movement to attack the law and the commission in the Legislature following its inauguration on Jan. 8. Just how effective the attack will be, and how far it will progress, is a matter of speculation. No secret is made of the fact that a bill will be introduced which will have for its object the repeal of the public utilities law and the abolishment of the commission.

When the last Legislature was in session the commission was the center of fire over an effort to withdraw one of its sharpest teeth, Sec. 48 of the utilities act, which gives the commission jurisdiction over public utilities and requires them to first secure a certificate of public convenience and necessity from the commission before starting operations. A bill was introduced to repeal the utilities law. It never reached the floor of the Senate and died in a committee. At that session there was also a concerted attack on the commission. It ended nowhere. An effort made to repeal Sec. 48 was defeated, but a compromise was reached to amend the law by which mining companies desiring electricity for power and lighting purposes could bring it into Idaho from another state. These mining companies were held not to be public utilities.

The fight on the commission at this time gives promise of becoming a lively one, but like others made heretofore it may die down after the Legislative hopper starts to grind. Several explanations are given for the latter possible condition, chief among which is a plank in the Democratic platform. This plank is as follows:

"We favor amendments to the public utilities act whereby that body shall be clothed with authority to pass upon and regulate the issuance of all securities of public service corporations."

When the public utilities law was passed by the Legislature four years ago it contained just such a provision as the Democratic platform plank declares for. It was this provision that proved to be the bone of contention over the passage of the law in that session. As passed by the House the act contained it. The Senate killed the provision and also a section allowing the commission to have its own attorney. Instead an amendment was attached to it placing the legal work in the hands of the Attorney General. The above plank is taken to mean, therefore, that the Democratic party is in favor of strengthening the public utilities law by adding to it the one provision which its most radical opponents defeated four years ago.

The antagonism toward the commission and the law creating it is largely due to the power given in Sec. 48. Opponents of the commission believe that this section should be killed so that competition in the public utilities field of Idaho will bring about greater development. They assert that competition is impossible and development stifled under a rigid enforcement of the section in that it gives the commission power over all classes of public utilities, permits it to give monopoly in a special field to one corporation as against another, and clothes the commission with too much power. The friends of the commission declare that to repeal Sec. 48 means the end of the usefulness of the commission, as most of its power is removed; that legitimate investment in a public utility or public utilities in any field is entitled to protection and that duplication of public utilities in a field that can be served by one utility, whether power, light, water, etc., means ruinous competition, the cost of which the public in the long run has to bear.

Illinois Commission

The order which the State Public Utilities Commission of Illinois entered on July 11, 1916, in the Jacksonville Rate Case (2698), prescribing gas, electric, and street-railway rates for Jacksonville (population about 18,000), has been vacated by the Commission upon an agreement of the parties to the original complaint, and a substitute order in lieu thereof was entered on Dec. 18, 1916.

Upon a refusal of the Commission to reopen and rehear the entire case, the Jacksonville Railway & Light Company (respondent) perfected an appeal to the Circuit Court of Sangamo County, where a stay of the rates determined by the Commission was secured upon agreement of all parties concerned. Features in the initial order were set forth in the ELECTRICAL WORLD of July 22.

No further action was taken in the Circuit Court, and no date was set for a hearing upon the questions at issue. Recently, the City of Jacksonville and the utility reached an agreement, which affected not only the rates for utility services, but many other matters as well, including certain controverted street-paving, franchises, gas service and other litigation.

The compromise rates are somewhat higher than those fixed by the previous order of the Commission, but are generally lower than those heretofore in effect in Jacksonville. The basis of settlement took into consideration the increased cost of fuel and other utility supplies since the date of the valuation, and the settlement runs for a period of one year. In vacating its previous order of July 11, 1916, the Commission eliminates a valuation of $565,000, but adheres to the requirement that the utility set up an annual depreciation fund of $21,100. The Commission, in permitting the compromise rates to become effective, retains jurisdiction over the subject matter.

The rate for residence service is 12 cents for first 50 kw.-hr., subject to 10 per cent discount for payment within ten days, and a minimum monthly bill of 75 cents. For commercial lighting the rate is 10 cents for the first 150 kw.-hr., with similar discounts for payment and similar minimum bill as for residence service. For motor service the rate is 8 cents for the first 50 kw.-hr., 6 cents for next 150 kw.-hr. and 5 cents for next 300 kw.-hr., with discount of 1 cent per kilowatt-hour for all energy used under 1000 kw.-hr. a month on bills paid within ten days of date of bill. The minimum is 50 cents per rated horsepower up to 5 hp., and 30 cents per horsepower for all in excess of 75 hp., provided no bill is less than $1 per month per meter. The railroad pays a fixed charge of $2,000 a year plus an energy charge of 1 cent a kilowatt-hour.

San Diego Supervision Charge.—Through a typographical error the supervision charge for which H. M. Byllesby & Company was contending in the San Diego Consolidated Gas & Electric Company rate case and which was allowed by the California Railroad Commission was stated on page 1261 of the ELECTRICAL WORLD for Dec. 23 as 25 per cent. This should have read 2.5 per cent.

Imposition of Delinquency Penalty Enables City to Cut Rates.—By imposing a penalty of $2 for delinquent customers who do not pay within thirty days, the city of Princeton, Ill., has been able to cut its rates for electricity from a 15-cent maximum to a 10-cent maximum. Consumers now pay quickly, thereby enabling the city to pay its own debts more promptly and to take advantage of discounts.

Electric Trucks for Films Involving Transportation.—Secretary Marshall of the Electric Vehicle Section, N. E. L. A., has sent a letter to the manufacturing members of the association suggesting that when a manufacturer arranges to develop a motion picture film involving transportation he consider the possibility of using electric vehicles. By so doing, Mr. Marshall says, "valuable publicity will effectively be lent to the electric vehicle."

Federal Appropriations for Bureau of Standards Electrical Investigations.—A bill has been introduced into the House of Representatives, and reported to the House committee on appropriations, making appropriations, among other things, for investigations by the Bureau of Standards for the year ending June 30, 1918. Among the investigations are the following: Electric current, danger in transmission, $15,000 (no increase); standards and methods of measurements of public utilities, $50,000 (increase, $10,000); radio communication, $10,000 (no increase).

Seventeen Pick Up Fallen Wire.—The curiosity of the human race knows no limit. In one of our large Eastern cities, says the **Au Sable News**, some men were at work installing a new wire on a busy street. For some reason the part of the wire that was already in place broke near one of the poles and fell to the ground. As the work of erection was not yet completed, the circuit was not in service and the wire was dead—but this fact was known only to the employees of the electrical company. One of the men, knowing the danger to the public from fallen wires, but also knowing that this particular wire was harmless, stood near by to note what action the passing throng would take. In fifteen minutes approximately 200 persons passed this point, and of this number twenty-two showed some curiosity regarding the wire. Of the twenty-two who stopped seventeen, all adults who might reasonably be supposed to know better, stooped down and took hold of the wire, or at least touched it, and then, finding it harmless, passed on. If the wire had been charged to a high potential, the first of the seventeen "doubting Thomases" would have been killed.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Final Hearing on Washington Code.—Proposed alterations in the code of overhead electrical rules were taken up for a final hearing by the State Public Service Commission at Olympia, Dec. 19, with more than 40 representatives of power, light and telephone companies and about a dozen representatives of organized electrical workers present. W. J. Canada of Washington, D. C., representing the National Bureau of Standards, explained the workings of the National Electrical Code.

Assistant Examiner, Patent Office.—The United States Civil Service Commission announces an open competitive examination for assistant examiner in the patent office, for both men and women, on Jan. 17, 18 and 19, 1917. From the register of eligibles resulting from this examination certification will be made to fill vacancies as they may occur in this position at the entrance salary of $1,500 a year, in the United States Patent Office, Washington, D. C. As the supply of eligibles for this position has not been equal to the demand, qualified persons are urged to enter this examination.

Storage of Soft Coal.—This year there appear to be more fires than usual, due to spontaneous ignition of piles of soft coal, according to the Underwriters' Bureau of the Middle and Southern States. As safeguards against the occurrence of such fires the bureau makes the following suggestions: "1. Storage should be kept, if possible, well away from the main buildings of the plant. Under no circumstances should it be piled up against a frame building. 2. If outside space will permit, the piles should be made low (not higher than 12 ft.), and of large area, rather than of small area, and piled high. 3. If wet coal is received, it should be dumped around the edges of the pile, or in some location where the air can get to it freely, and where large quantities of other coal will not be packed on top of it 4. If large amounts are stored, it is a good plan to insert wrought-iron pipe 2 in. or 3 in. in diameter into the piles as they are built up. The lower ends of these pipes should be at different heights from the ground throughout the piles, and probably one 3-in. pipe to every 400 sq. ft. of surface would be ample. This arrangement allows air to circulate freely through the coal pile, and is a great aid in preventing spontaneous ignition. The pipes should preferably be perforated, and it is a good plan to lower a thermometer occasionally through one of them to get a temperature reading from the center of the pile."

Ambulances Heated Electrically.—All of the latest type of ambulances on the western front of the European battlefield are equipped with electric heaters fed from storage batteries. If a badly-wounded soldier can be kept warm during the trip from the battlefield to the hospital the chances for recovery are so much better. In this respect the electrically-heated ambulances, it is reported, are proving to be very satisfactory.

Company Voluntarily Reduces Rates.—The Worcester Suburban Electric Company of Uxbridge, Mass., has announced its third and fourth reductions in the cost of electric energy to its local customers. A reduction of 0.5 cent per kilowatt-hour from the present 14-cent rate will be effective after Jan. 1, 1917. And there will be another additional reduction of 0.5 cent per kilowatt-hour for all electric current used and billed to customers after July 1, 1917.

Municipal Ownership Legislation Desired in North Dakota.—Comprehensive legislation to make effective a more general establishment of municipally-owned public utilities, it is understood, will be laid before the North Dakota Legislature this winter as a result of the action of the Fargo Trades and Labor Assembly, which has placed under way in Fargo a movement for the establishment by that city of a municipally-owned electric power plant. Preliminary steps toward the adoption of a legislative program covering the problem have already been taken, it is announced, but the exact nature of the bill that will be presented has not yet been determined. North Dakota, the labor leaders of Fargo point out, is at the present time without an adequate act covering municipal ownership.

Research Fellowships in Engineering Experiment Station.—To extend and strengthen the field of its graduate work in engineering, the University of Illinois maintains fourteen engineering experiment station research fellowships. These fellowships, for each of which there is an annual stipend of $500, are open to graduates of approved American and foreign universities and technical schools. Appointments to these fellowships are made and must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the degree of Master of Science will be conferred. Not more than half of the time of the research fellows is required in connection with the work of the department to which they are assigned, the remainder being available for graduate study. Nomination to fellowships, accompanied by assignments to special departments of the engineering experiment station, are made from applications received by the director of the station each year not later than the first day of February. Preference is given those applicants who have had some practical engineering experience following their undergraduate work. Appointments are made in the spring and they take effect the first day of the following September.

Investments Discussed at Dallas.—William H. Black of San Antonio on Dec. 15 addressed the Dallas Electric Club and Jovian League on the subject "Electricity as a Legitimate Field for Investment."

H. M. Byllesby Addresses Chicago Club.—At the Dec. 28 meeting of the Electric Club-Jovian League of Chicago, H. M. Byllesby of H. M. Byllesby & Company spoke on "The Electrical Man's Responsibility to His Country." The annual dinner will be on Jan. 18.

Arc Oscillators from High-Power Radio Stations.—At the regular meeting of the Los Angeles section, A. I. E. E., Dec. 19, August Hund, department of physics and electrical engineering, University of Southern California, presented a paper entitled "Arc Oscillators for High-Power Radio Station.'

Motion Pictures of Pipe Manufacture.—A series of three industrial motion picture films, illustrating the manufacture of pipe, from ore to finished product, was shown before the Lynn section, American Institute of Electrical Engineers, on Dec. 20. These pictures were taken under the direction of the National Tube Company, Pittsburgh, Pa., after eight months' work.

Meeting of Portland Electrical Men.—The Portland (Ore.) sections of the American Institute of Electrical Engineers, National Electric Light Association and Oregon Society of Engineers held their fifth bi-weekly luncheon at the Oregon Hotel, Portland, on Dec. 20. The luncheon was in charge of the Oregon Society of Engineers, with E. G. Hopson, consulting engineer, acting as chairman. The guests were addressed by Judge C. U. Gantenbein on "The New National Defense Act."

Doherty Addresses Kansas City Jovians.—Henry L. Doherty addressed the Jovian League of Kansas City at its banquet at the Hotel Muehlebach on Dec. 21. There were 250 Jovians present in festival caps, and the enthusiasm of the occasion was heightened by the presence of the reigning Jupiter. Mr. Doherty spoke at length on the effect on the public at large, especially the laboring classes, of legislation regulatory of corporations during the past few years. Mr. Doherty also spoke of the Jovian League as the means by which extraordinary progress in the electrical industry might be gained in the next few years. He referred to his plan for setting specific weeks for various centers, during which Jovians would report on their observations of opportunities for saving labor through the use of electricity—the suggestions to be received by experts assigned to the cities during the weeks set, and by them worked out into practical form. The Jovians were especially glad to entertain also at the banquet John H. Lucas, president of the Kansas City Light & Power Company. Mr. Lucas spoke on the opportunities for young men in the industry, and dwelt on the factors of success in any business—the necessity for careful training, diligence, good habits and square dealing, and, above all, of service to the public.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Oregon Engineers Hold Electrical Night.—The Oregon Society of Engineers of Portland, on Dec. 22 celebrated "Electrical Night" at the Portland Chamber of Commerce. The following program was heard: "Recent Achievements in the Electrical Field," by O. B. Coldwell, general superintendent Portland Railway, Light & Power Company; "Historical Phases of Electricity," with special reference to local conditions, by R. R. Robley, operating engineer Portland Railway, Light & Power Company; "Commercial Application of Electricity," by W. H. Lines, commercial engineer Portland Railway, Light & Power Company.

Edison Junior Christmas Party at Chicago.—The Commonwealth Edison Section of the National Electric Light Association gave an Edison Junior Christmas party in Customers' Hall on the evening of Dec. 22. Invitations were extended to all members and their children. It was the aim to make this juvenile Christmas party something new in the social and welfare work of central station companies. The affair presented one of the few opportunities which are given the families of employees of such a large organization to become acquainted. To interest the little folks there was a Christmas tree, and Santa Claus with a gift for each child. Among the other juvenile entertainment features there was a Punch and Judy show performances by a ventriloquist, a magician, and a troupe of trained dogs.

Illuminating Engineers to Hold Headlight Symposium.—The Illuminating Engineering Society will hold a meeting on Jan. 10, in the Engineering Societies Building, New York City, which will be devoted to the subject of automobile headlights. A paper is to be presented by W. F. Little of the Electrical Testing Laboratories, entitled "A Survey of the Automobile Headlight Situation." This paper will present a symposium of the opinions of various men in the lighting and automobile engineering fields in an attempt to arrive at a consensus of opinion as to the requirements. The paper will then describe various headlights upon the market, and in connection with these a demonstration will be made of the lamps which are in general use, together with several types which have not as yet been placed upon the market. Following the presentation of this paper it is planned to hold a symposium of engineers, legislative authorities, police officials, etc., in an attempt to secure a good discussion of the headlight problem from a number of different viewpoints.

Missouri Contractors to Meet in Kansas City.—The Kansas City Electrical Contractors' Association will entertain the Missouri Association at the annual meeting of the latter in Kansas City late in January. Extensive plans are under way.

Opportunities for Men in Electrical Industry.—A meeting of the New York Companies' Section of the National Electric Light Association was held at the auditorium of the New York Edison Company on Dec. 19. The meeting was addressed by F. M. Feiker, editor of the ELECTRICAL WORLD, and Theodore Rousseau, secretary to the Mayor of the City of New York. Mr. Feiker spoke on "Opportunities for Men in the Electrical Industry." He made the point that the central station includes within itself practically all the activities of the industry, from science through manufacturing, operating, management and sales. Mr. Rousseau spoke on the work of city administration, saying that many of the problems of managing the city were the same as those of managing any business. At the meeting a vote was taken on the name for the branch paper. It was voted to call it *The Volt Age* and a prize of ten dollars was awarded to Arthur H. Miller, the author of the name chosen. The meeting closed with an entertainment program. About 300 attended the meeting.

Meeting of Cleveland Section of Institute.—The Cleveland section, American Institute of Electrical Engineers, held its regular monthly meeting on Dec. 18 in the Electrical League rooms at the Hotel Statler. There were about seventy-five in attendance to hear J. D. Wright speak on "Speed Control of Induction Motors for Rolling Mill Drive." Mr. Wright, who is engineer of the power and mining department of the General Electric Company at Schenectady, illustrated his talk with numerous slides, and an interesting discussion followed the reading of his paper. It was also decided at this meeting to establish an advisory board for the Cleveland section, composed of the past chairmen. This board is to be headed by the chairman who has been most recently superseded. Another important step taken at the meeting was the appointment of a committee whose duties will be to bring about a more harmonious relation between the Cleveland section and the other electrical societies of the city, especially the Cleveland Engineering Society and the Electrical League. E. W. P. Smith was appointed chairman of this committee, and the other two members are Prof. H. B. Dates of Case School and W. M. Skiff of Nela Park. The committee feels that there are excellent possibilities in the future of the Institute, Cleveland Engineering Society and the Electrical League joining forces and obtaining central headquarters, and as these societies grow there will be greater possibilities of erecting a joint clubhouse. Representatives of the other electrical organizations were in attendance at the preliminary meeting and are heartily in favor of this co-operative activity, inaugurated by the Institute.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

SUPPLY OF MAGNET WIRE SMALL

Demand Coupled with Inability to Get Sufficient Copper Reduces Stocks

The 1916 production of magnet wire has greatly surpassed that of any previous year. Motor production and generator production have both been tremendous, and naturally the quantity of dynamo-electric machinery in use has considerably increased. Because of the large number of pieces of electric machinery in use, and also because so many second-hand motors and generators once taken out of service have again been put to use, repairs have been much larger than usual.

It has been impossible to thoroughly supply this demand for magnet wire, and consequently local stocks for repair purposes are very small and in many instances have dwindled to nothing. So serious has this become that some central stations, being alarmed, have sent notices to power customers urging that the highest degree of care be taken with motors, as it will practically be impossible to effect repairs without considerable delay.

Inquiries resulted in statements that the situation was further aggravated by the difficulty in obtaining a sufficient supply of copper.

JOBBERS' OVERHEAD COSTS INCREASING VERY RAPIDLY

Increase in Number of Small Orders Responsible—Retail Business Now Being Done by Local Jobber on Wholesale Prices

For a number of years the overhead expense of the electrical jobbing business has been increasing rapidly and, inasmuch as the profits do not show a corresponding increase, it is being viewed with alarm in many quarters. The reason is the increasing number of small orders that the jobber is called upon to handle. It has come to a point where the electrical jobber is now doing a large retail business at oftentimes wholesale prices.

To a large extent this has been due to the localization of the electrical jobbing business. Many large cities have one or more electrical jobbing houses, and contractors and dealers find it very easy to buy supplies from the local jobber as needed. In other words, the local jobber is selling retail lots at quantity prices. He must maintain the electrical supply stock for the entire community.

In addition there are many new pieces of electrical supply apparatus being placed on the market each year. Quite frequently are there new articles brought out without any thought as to the method of marketing or distribution.

When the matter of selling small lots at wholesale prices is brought to the attention of the local jobber he quickly replies that he has made the customary profit of 15 per cent or 20 per cent. The entire transaction is regarded as one on which a per cent profit is made. No account apparently is taken of the gross profit per transaction. A large number of transactions are made where the amount of the sale is under $1. On a basis of 20 per cent profit the gross profits on such sales are under 20 cents.

Buying as close as he does and selling to such a limited market, a sale such as the above actually means a loss to the jobber. It has frequently been stated that no electrical jobber can afford to do a wholesale business on transactions where the amount involved is less than $5. In other words, it practically costs a jobber $1 to make a sale.

Two remedies have been suggested. The first is that of the retail business is to be retained by the jobber, then he should charge the retail price, the same price that the contractor and dealer charges. The other would make it unethical to sell in less than wholesale lots by establishing standard packages as sale units. Any purchaser, then, who cannot buy in standard package lots would have to buy from the retailer.

COPPER QUOTATIONS LOWER

Manufacturers Having Overpurchased Weaken Market by Offering Small Lots for Resale

From its high point of 36 cents a little over two weeks ago, prompt delivery electrolytic copper had dropped early this week to 31.50 cents, with no buyers. January copper was quoted at 30.75 cents. Copper for the first quarter of 1917 was quoted at 30.25 cents, second quarter 29.25 cents, third quarter 28.25 cents and last quarter 27.27 cents.

In spite of the fact that large producers declared that they were sold out well into 1917, and that unsold production for the rest of 1917 was small, the market was unable to withstand the uncertainties that would be contingent upon peace. There was every evidence also that buyers had overstocked. It was really this latter class, and not the speculators, who forced the market down. The stocks held by speculators were really not very large and therefore could have but little effect on the market, especially if the manufacturers wished to protect the prices of their own stock. Many manufacturers, however, did not care to do this, as they had protected adequately, by orders for future delivery, their copper stocks and were therefore willing to take a profit on present excess stocks. Frequent offerings of resale copper in lots of under 500 tons cut the quotations to near the 30-cent mark.

One thing is significant, and that is the drop in quotations for delivery during the second half of 1917. When spot copper first began to fall in price long-delivery copper held very firm. It was then pointed out that manufacturing demand for long deliveries was sufficient to hold up the price. Now there is apparently some apprehension on the part of the producers that such might not be the case.

Copper wire base fell off to 37.50 cents for prompt delivery and 35.50 cents for February delivery.

ADVANCE IN ELECTRIC HEATING APPLIANCE PRICES

Excessive Cost of Raw Materials and Labor Allow Unsatisfactory Margin of Profit at Former List

Beginning Feb. 1 the minimum list price of certain electric-heating devices licensed under the Marsh patent for a nickel-chromium resistance element will be advanced. The advance will be $0.50 on the ordinary household flatiron and on toasters and $5 on ranges. The minimum list price on the other appliances will not be raised at this time.

These advances are due to the excessive costs of raw materials and of labor. Some of the manufacturers have found it impossible to obtain a satisfactory margin of profit under the present minimum prices, and in certain instances appliances have been listed at prices above the minimum license price. All the manufacturers, however, were not willing to do this independently; and inasmuch as the license agreement was drawn up partly to effect a standardization of prices in order to insure a uniformity of quality of product, it was felt necessary to have some action that would bind all manufacturers.

Even with the new minimum it is doubtful if a satisfactory profit will be found by all manufacturers. In fact, it is understood that some manufacturers will take the stand that, since a price increase must be made at this time, the price should be increased with an eye to future increase in raw-material costs and to insure a better profit. For this reason there is occasion to believe that in all probability certain makes of flatirons and toasters which under the present license arrangement list for $4 will not only go to $4.50 on Feb. 1, because of the new arrangements, but will go to $4.75 or $5.

All orders taken at current prices must be shipped before Feb. 1 in order to escape the advance. Considering the rushed and already swamped condition of a number of heating appliance factories, it is doubtful if many orders will be accepted for delivery before Feb. 1. Some manufacturers, it is known, have withdrawn all quotations and will accept orders subject to a new schedule which will probably not be announced until after the first of the new year.

MARKET CONDITIONS RAISE COST OF DOING BUSINESS

Long Distance Telephone Calls and Personal Visits to Sellers and Other Similar Items Make Considerable Totals

Besides the rising costs of raw materials and labor there is another manufacturing cost that has assumed considerable proportions during the past twelve months, namely, the cost of doing business. With the electrical manufacturer it costs almost as much to sell his goods as before, because he has kept his sales force intact. However, in the matter of buying materials and equipment, costs have spurted along. Formerly if some manufacturing materials were wanted a letter from the purchasing department would bring around a few salesmen immediately. Now, in nine cases out of ten, a letter will not even bring a quotation. The purchasing department must therefore do business in a more direct way. To-day if stock is wanted the purchasing agent either telephones or takes a trip to the seller. Practically all inquiries are handled over the telephone. Long-distance calls of more than 1000 miles to place orders are by no means infrequent. These charges mount up rapidly.

It costs considerably more to hire labor to-day than formerly, because labor is so uncertain. A shop in New England hires more than 2000 men a month to maintain a force of 200 men. Where there are regulations requiring physical examination before an applicant shall be permitted to start work another large bill is run up. Furthermore, where the duties of keeping a sufficient number of employees at work have increased so much a larger employment bureau force has become necessary.

There are a number of other similar charges, no one of which is large in itself but which added together make a very appreciable figure. They are all new costs incidental to the market conditions that now obtain.

UNCERTAINTY EXISTS IN REGARD TO FUTURE MARKET

Possibility of Peace Negotiations Causes Many Jobbers to Hold Back from Buying in Anticipation of Lower Prices

For a long time there has existed an uncertainty about the future market for electrical appliances that has kept jobbers from buying too heavy. Now that the question of peace is being considered, this uncertainty has increased to a point where jobbers are hesitating before placing further orders to see what Europe plans to do.

There is no doubt in the minds of the trade that copper will drop somewhat in price should the war end. The present agitation was sufficient to bring the quotations down about 4 cents.

Manufactured products, of course, will probably not respond as quickly as the market for raw materials, but it is doubtful if purchasers will enter the market at the high prices when it may be only a matter of a few weeks until prices will come down. In such cases jobbers will have to accept a loss in the decreased value of their stocks.

If jobbers were certain that prices would remain where they are or advance during the next six months they would no doubt stock up heavily. Some jobbers will, of course, take a chance, but the more conservative are unwilling to lay in large stocks at present prices except where it can be definitely ascertained that the price will not fall.

Furthermore, electrical jobbers and contractors are not accepting orders for future delivery except on the basis of delivery price or where the manufacturer will quote a price. The jobbers expect to take a loss when the market falls, but they are taking all precautions to make this loss as small as possible.

ELECTRICAL EXPORTS IN 1916 BREAK ALL RECORDS

October Figures Reach Record Value of $4,045,645, Bringing Totals for First Ten Months of Current Year Up to $31,073,268

Based on the figures reported to the government for the first ten months of the current year, exports of electrical goods of American manufacture will reach in value in 1916 a new high record. It is estimated that the 1916 electrical exports will be well in excess of $37,000,000. If the volume of exports for the three months last reported—August, September and October—has been maintained during November and December, then the above estimate will be too small by more than $1,000,000.

October was another heavy export month, being larger than any previous month. The volume of electrical export business in that month was $4,045,645, in comparison with $2,179,453 in the preceding October. The exports of batteries, generators, insulated wire and cable, carbon filament lamps, motors and miscellaneous merchandise during October last were greater in value than ever before. Attention is called particularly to miscellaneous merchandise, of which almost $2,000,000 was exported in October. In the ten months January-October the exports in this class have almost doubled in value.

Exports of electrical goods amounted to $31,073,268 during the first ten months of 1916, in comparison with $19,419,403 and $16,697,829 during the corresponding periods of 1915 and 1914 respectively. The largest items in the list are: Batteries, $1,504,788; generators, $1,379,153; insulated wire and cable, $3,587,342; metal filament incandescent lamps, $1,165,509; motors, $3,993,233; telephones, $1,322,939, and miscellaneous merchandise, $15,266,360.

During the past three years a steady growth has been noticeable in the exports of batteries, insulated wire and cable, metal filament incandescent lamps, meters, motors, telegraph instruments and miscellaneous equipment.

In the accompanying table are shown the exports by value of electrical goods of American manufacture as reported by the Bureau of Foreign and Domestic Commerce for the month of October:

Articles	October		Ten Months Ending October	
	1915 Value	1916 Value	1915 Value	1916 Value
Batteries	$82,554	$173,734	$1,069,932	$1,504,788
Dynamos or generators	137,445	249 281	1,696,958	1,379,153
Fans	34,578	13,949	298,492	269,180
Insulated wire and cables	201,856	575,024	2,284,634	3,587,342
Interior wiring supplies, etc., including fixtures	63,307	89,214	726,344	735,838
Arc lamps	1,234	644	18,476	13,590
Carbon filament lamps	17,223	27,164	121,684	98,770
Metal filament lamps.	106,428	98,908	645,487	1,165,509
Meters and other measuring instruments..	56,272	80,895	503,553	705,137
Motors	290,623	526,231	2,751,623	3,993,233
Telegraph instruments (including wireless apparatus)	30,171	18,366	110,535	139,127
Telephones	72,493	105,146	792,593	1,322,939
Transformers	64,908	90,367	516,571	892,302
All other	1,020,361	1,996,722	7,882,521	15,266,360
Total	$2,179,453	$4,045,645	$19,419,403	$31,073,268

Manufacturing and Industrial

Electrical Alloy Company, Morristown, N. J., presented a 5 per cent Christmas bonus to its employees. The company has the first section of its new building nearly completed, and expects to move in within two or three weeks.

Robbins & Myers Company announces that on Jan. 1, 1917, the Rochester office will be removed to 740 Elicott Square Building, Buffalo, N. Y. L. Larsen, the present manager of the Rochester office, will have charge of the Buffalo office.

Samuel M. Hofheimer, Philadelphia, Pa., announces that he is now located in the Bulletin Building, where he will continue to represent the Monarch Refillable Fuse Company; the Davidson & Stevenson Porcelain Company; the Dielectric Manufacturing Company, and the Cap-Swivel-Let Company. Mr. Hofheimer also announces that he has taken over the business of the Electrical Service Equipment Company of Philadelphia.

Menominee (Mich.) Electric Manufacturing Company announces that it has recently purchased the entire property and stocks of the Kandem Electric Company, 29 East Twenty-first Street, New York City. For the time being this company will retain its name, acting, however, as the division of the home office in charge of the New England territory. P. M. Dreyfus, treasurer of the Kandem company, will be manager of the new district offices.

The Blackburn-Smith Corporation, 105 West Fortieth Street, New York City, through purchase of the filter department of James Beggs & Co., has acquired all patents, records, patterns and rights for the manufacture and sale of the Blackburn-Smith feed-water filter and grease extractor and the Blackburn-Smith sewage ejector system. The engineers and agents previously identified with these products have been taken over in a body by the new corporation and will in future work under the direction of Irvin H. Kaufman, vice-president, who has supervised the manufacture, sale and installation of the Blackburn-Smith filter for the past ten years.

Universal Display Prize-Winners.—Prizes have been awarded in the window display contest of Universal Percolators, as follows: First prize, Vonnegut Hardware Co., Indianapolis, Ind.; second prize, Schoedinger-Marr Co., Columbus, Ohio; third prize, Sterling Electric Co., Minneapolis, Minn. The judges were W. C. Warren, president, House Furnishing Review Company; P. F. O'Keefe, president, P. F. O'Keefe Advertising Agency; Herbert Flansburgh, Herbert Flansburgh Advertising Service. A large number of displays were entered and the judges stated that the photographs of windows contributed in this contest are the best that have been shown since the contests have started.

Beckman & Linden Engineering Corporation, 604 Balboa Building, San Francisco, Cal., was recently incorporated for the purpose of carrying on consulting and development work in civil, electrical, metallurgical and chemical engineering, the partners being J. W. Beckman and H. E. Linden. Their activities will embrace investigations of the natural resources adjacent to existing or prospective power developments, with a view to developing new industrial uses of power; investigation of hydroelectric developments, designing and construction of power developments and industries for power consumption, and the managing of such organizations. They will maintain a laboratory and are prepared to undertake any research work in chemistry, electro-chemistry and electro-metallurgy. They are also prepared to finance such prospective developments as appear promising.

Wagner Electric Manufacturing Company announces as incident to its extensive expansion various changes in sales office personnel and locations and in departmental heads. These include the following: The Chicago office will remove to 918 South Michigan Avenue, where it will combine with the service station. The Boston office will remove to 88 Brookline Avenue, where it will combine with the service station. The San Francisco office will remove to 159 New Montgomery Street, where it will combine with the service station. P. B. Postelthwaite, formerly manager of the Cincinnati office, is now in charge of the service department with headquarters at the home office. J. W. Bryant, formerly in charge of the Buffalo and Syracuse offices, is now Cincinnati manager, C. P. MacGonigal of the Philadelphia office will be in charge of the Syracuse and Buffalo offices. The St. Louis service station is now under the direction of C. M. McCord, who was with the home office.

Profit-Sharing and Group-Insurance for Sperry Employees.—Life insurance policies and profit-sharing premiums to the approximate value of $1,000,000 were distributed on Dec. 23 to 900 employees of the Sperry Gyroscope Company, Brooklyn, manufacturers of gyro-compasses, ship stabilizers and high-intensity searchlights. The profit-sharing premiums cover a period from Oct. 1 to Dec. 31, but will be continued in the future. The individual amounts were determined according to a sliding scale, depending upon the length of employment, but includes all employees, whether they had been with the company five years or longer or only three months. The group life insurance policies, issued by the Travelers' Life Insurance Company, are for each individual employee's last annual earnings and include disability benefits. The latter provides that any employee under sixty years of age incapacitated for further service with the company by either injuries or disease, may obtain settlement for the full amount of his policy in not less than five annual installments, all undrawn installments to be credited with compound interest. In the event of the death of the insured employee prior to the collection of the final installment, the beneficiary will receive the balance.

Dividend Bonus for Doehler Die-Casting Employees.—Realizing the increasing cost of living the Doehler Die-Casting Company, Brooklyn, N. Y., has announced to its employees the following plan for an extra participating dividend on wages: Beginning Jan. 1, 1917, whenever this company declares the regular dividend on its stock it will also declare a wage dividend amounting to 10 per cent per annum to all employees based on all wages actually received, including piece work and overtime. This wage dividend is subject to the following conditions: An employee must be in the company's employ without interruption for a full year before he can participate in the wage dividend. Upon completion of a full year's employment he automatically becomes a candidate for this wage dividend. His wage dividend will be calculated from the date of completing the first year's employment to the date of declaration of dividend. This wage dividend when declared will be applied as follows: First—Will be paid in full to all employees who have been in the company's employ a full period of three years or more; second, two-thirds will be paid to all employees who have been in the company's employ for a full period of two years and less than three years; third, one-third will be paid to all employees who have been in the company's employ for a full period of one year and less than two. This wage dividend will be declared quarterly the same as the stock dividend. It was further announced that beginning Jan. 1, 1917, all employees who have been working on the basis of fifty hours per week, will be put on a basis of forty-eight hours per week at the same pay. This company employs 1200 men, and has a weekly payroll of approximately $25,000.

NEW YORK METAL MARKET PRICES

	Dec. 19 Selling Prices Bid	Dec. 19 Selling Prices Asked	Dec. 26 Selling Prices Bid	Dec. 26 Selling Prices Asked
Copper	£ s d	£ s d	£ s d	£ s d
London, standard spot	142 10 0		141 10 0	
Prime Lake	32.00	to 32.50†	31.00	to 31.50†
Electrolytic	34.00	to 34.50†	31.00	to 32.00†
Casting	31.00	to 31.50†	29.50	to 30.00†
Copper wire base	40.00†		37.00	to 38.00
Lead	7.50		7.50	
Nickel	50.00		50.00	
Sheet zinc, f.o.b. smelter	21.00		21.00	
Spelter, spot	10.17½	to 10.67½	9.80	to 10.00
Tin, straits	42.50		40.62½†	
Aluminum, 98 to 99 per cent.	59.00	to 61.00†	60.00	to 64.00†

OLD METALS

Heavy copper and wire	27.00	to 29.00†	27.00	to 27.50†
Brass, heavy	16.00	to 17.50†	15.00	to 15.50†
Brass, light	13.00	to 13.25†	10.50	to 11.00†
Lead, heavy	6.75	to 6.87½†	6.50	to 6.75†
Zinc, scrap	7.00	to 8.00†	7.50	to 8.00†

COPPER EXPORTS

Total tons to Dec. 26 19,893

†Nominal.

Corporate and Financial

Acme Wire Company, New Haven, Conn.—A block of $500,000 of new capital stock has just been sold, making the total outstanding $1,000,000.

Cities Service Company, New York, N. Y.—At its regular monthly meeting held on Dec. 20 the board of directors, in addition to the cash dividend of 0.5 per cent upon the preferred and common stocks, declared a dividend of 2 per cent in common stock at par, payable Feb. 1, 1917, to common stockholders of record on Jan. 15. It will be remembered that last May the directors established the policy of paying 6 per cent stock dividends in 1917, these to increase by 3 per cent each year thereafter so long as the company's increasing earnings were sufficient to warrant such action. The declaration of the Feb. 1 dividend of 0.5 per cent indicates that it is the apparent intention of the board to pay the stock dividends monthly, the same as the cash disbursements. As no dividends are paid or accrued upon fractional shares of stock, the directors announced that the company had made arrangements with Henry L. Doherty & Company to keep in trust for any stockholder desiring to take advantage of the offer such fractional shares as may be payable monthly from the stock dividends declared. Under this plan Henry L. Doherty & Company will receive the fractions from the Cities Service Company and consolidate them into full shares. The cash and stock dividends received on these whole shares will then be credited to the accounts of the respective stockholders in proper proportion. When the accumulations of stock aggregate one integral share certificate will be forwarded to the stockholder, together with cash accumulations up to that time.

Keystone Utilities Company, Scranton, Pa.—The unsold portion of $1,225,000 of first and consolidated mortgage collateral 5 per cent gold bonds is being offered at 91.5 and interest with a 50 per cent allotment of stock.

Kings County Electric Light & Power Company, Brooklyn, N. Y.—In connection with the issue of $2,500,000 of convertible debentures and the $1,900,000 of demand notes of the Edison Electric Illuminating Company of Brooklyn, authorized by the Public Service Commission for the First District of New York early in December to be issued, the commission has imposed several conditions: First, that there shall be authorized an increase of the capital stock of the Kings County company to provide for the conversion of the bonds into stock. Second, that the Kings County company shall sell debentures at not less than par or face value plus accrued interest, and that the proceeds shall be applied only to the purchase of the Edison Company's demand notes and to the reimbursement of the Kings County company for moneys expended from income as mentioned above. Third, the Edison company's demand notes to be applied only to expenditures for acquisition of property, for the construction, completion, extension or improvement of its facilities or renewals thereof, or to cover obligations entered into for the same general purposes. Fourth, the debenture issue shall be offered for subscription at par and accrued interest, first to the stockholders of the Kings County company, and second, as to any remainder, to the Brooklyn Edison investment fund. The latter is a fund created and accumulated pursuant to a profit sharing and pension plan of the Edison Electric Illuminating Company of Brooklyn. In the event that all of the issue of debentures is not subscribed for by stockholders or by the Brooklyn Edison investment fund, the remainder may be disposed of to the general public. Fifth, the Kings County company and the Edison company are required to account to the commission disbursements made under the securities' issues. Other provisions of the order provide that no proceeds of the debenture issue shall be paid over to the Kings County company by the Edison company until a demand note or notes are tendered by the Edison company to the Kings County company. The authority to issue notes or debentures under the order expires on May 31, 1917.

Lewiston-Clarkston Improvement Company, Lewiston, Idaho.—Deeds have been filed by the company for the sale of its electric power plants and irrigation system to the Washington-Idaho Water, Light & Power Company. The consideration of the sale is $800,000. With the filing of the deeds a bond mortgage in favor of the Equitable Trust Company of New York was also placed on record, this instrument authorizing a present bond issue of $600,000 and a future issue of $4,400,000 to meet future developments. The plans of the purchasers embrace the construction of a dam in the Snake River at a point 3 miles below Lewiston and Clarkston, which will develop 50,000 hp., the development to also raise the harbor depth at Lewiston 8 ft.

Mahoning & Shenango Railway & Light Company, Youngstown, Ohio—An issue of $3,467,000 of 7 per cent cumulative preferred stock is being offered at 102.5 and accrued dividend. This preferred stock was originally sold for cash at par to the Republic Railway & Light Company, which controls the Mahoning & Shenango Railway & Light Company. Of the total issue $3,000,000 was deposited as collateral to secure an issue of the Republic company three-year 5 per cent notes. All of these notes were called for payment, the cash for this purpose being realized from the sale of this preferred stock. Holders of notes had the right to convert their notes at par for preferred stock, and upwards of $500,000 notes were so converted. The additional $500,000 preferred stock was issued to pay for improvements to the properties and for other capital expenditures.

Ohio Service Company, Cambridge, Ohio—An issue of $400,000 of convertible 6 per cent mortgage notes due Nov. 1, 1917, is being offered at par and interest. The company covenants either to pay the notes in cash on maturity or to tender to the note holder an equal amount of first mortgage 6 per cent bonds due Nov. 1, 1937.

Western United Gas & Electric Company, Aurora, Ill.—A block of general mortgage 5 per cent gold bonds due Feb. 1, 1950, has just been offered at 94.5 and interest to yield 5.35 per cent.

Wisconsin Edison Company, Milwaukee, Wis.—An extra dividend of 75 cents a share has been declared payable Dec. 30, to holders of record Dec. 15. This is in addition to the semi-annual dividend of $1.75 per share.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.—A quarterly dividend of 1.75 per cent, an increase of 0.25 per cent quarterly, has been declared, payable Jan. 31 on common stock of record Dec. 30. This places the common stock on a 7 per cent basis. At the same time the regular 1.75 per cent quarterly dividend on preferred stock was declared, payable Jan. 15 to stockholders of record Dec. 30. The increase in the common dividend, it is understood, is made from profits in the regular lines of company's business and is in no sense due to profits on munitions contracts.

Western States Gas & Electric Company, Stockton, Cal.—The company has arranged for the purchase of large water rights which will make its present water power on the American River at Placerville, Cal., a 100 per cent effective power all the year. Authority for the purchase is being sought from the California Railroad Commission. The expenditure involves an outlay of approximately $190,000 and covers four large lakes, a number of minor ones, and an irrigating system in Eldorado and Amador counties. There is already an established income from the irrigating business sufficient to more than pay interest charges on the purchase price. It will now be unnecessary for the Western States Company (Stockton Division) to purchase water during drought seasons as in the past. The purchase gives the company assurance of being able to supply all power demands for years to come.

New Utility and Industrial Companies

The Battery Service Company of Lafayette, Ind., has been incorporated by Lafayette Jamison, Herbert H. Johnson and Franklin E. Hall. The company is capitalized at $5,000, and proposes to manufacture automobile batteries.

The Weco Manufacturing Company of Boston, Mass., has been chartered with a capital stock of $50,000, to manufacture electrical, gas and oil-heating appliances. The directors are: Hans R. Boker, president; Harry B. Eaton of Waban, treasurer; and J. Leo Hickey.

The Farad Electric Company of Cleveland, Ohio, has been chartered, with a capital stock of $500,000. The incorporators are: E. A. Foote and others.

Woodward (Pa.) Electric Light Company has been incorporated, with a capital stock of $5,000. W. S. Harris of Lock Haven is one of the incorporators.

The Kawishiwi Power Company of Ely, Minn., has been organized to construct a 7000-hp. hydroelectric power plant. T. W. Orbison of Appleton, Wis., is engineer.

The Castanea (Pa.) Electric Light Company has been granted a charter, with a capital stock of $5,000. W. S. Harris of Lock Haven is interested in the company.

The Dunstable (Pa.) Electric Light Company has been granted a charter, with a capital stock of $5,000. W. S. Harris of Lock Haven is interested in the company.

The South Bend (Ind.) Current Control Company has been incorporated by Dana E. Wescott, Charles H. Zwergel and Harvey Koontz. The company is capitalized at $15,000, and proposes to manufacture electrical appliances.

The Bakertown Light, Heat & Power Company of Elmora, Pa., has been incorporated, with a capital stock of $5,000. The incorporators are: A. W. Evans, S. C. Evans and L. S. Jones of Ebensburg, Pa.

The Alexandria (Ohio) Public Service Company has been incorporated by C. W. Shaw, J. H. Gosney, A. Thurner and N. C. Zinn. The company is capitalized at $2,000, and proposes to furnish electricity in Alexandria.

The Central Power & Light Company of Boston, Mass., has been incorporated, with a capital stock of $1,000,000. The directors are: L. B. Hardwick, president; E. C. W. Johnson, Clark Road, Brookline, treasurer; and J. S. Sanborn.

The Red Boiling Springs (Tenn.) Light Company has been incorporated by J. B. Birdwell, H. C. Hessen, C. B. McClelland, B. W. Chitwood and H. Smith. The company is capitalized at $2,000, and proposes to generate and distribute electricity in Red Boiling Springs.

The Canaseraga (N. Y.) Heat, Light & Power Company has been chartered by H. E. Robbins, J. J. Bennett and W. C. Windsor of Canaseraga. The company is capitalized at $6,000, and proposes to supply electricity for lamps, heaters and motors, and for transportation purposes.

The Columbia Gas & Electric Fixture Company of New York, N. Y., has been incorporated, with a capital stock of $20,000, to manufacture and deal in gas fixtures, electroliers, etc. The incorporators are: H. and B. Kaplan and M. Markowitz, 291 Broadway, New York, N. Y.

The Electric Tool & Appliance Company of Milwaukee, Wis., has been organized, with a capital stock of $20,000, to manufacture patent box cutters and scientific laboratory apparatus. Oscar Werwath is president and William Baum is secretary and treasurer, Stroh Building, Milwaukee.

The Simplex Instrument Company of Newark, N. J., has been incorporated, with a capital stock of $125,000, by Frederick Beck, R. G. Higgins, of Newark, N. J., and Edward W. McDonough of Orange, N. J. The company proposes to manufacture hydrometers, thermometers, battery meters, etc.

The Tarkas Company of Providence, R. I., has been granted a charter, with a capital stock of $10,000, for the purpose of manufacturing machinery, tool appliances, and tools connected with the electrical industry. The incorporators are: Kark Tarkas, Henry C. Hart and Patrick P. Curran of Providence, R. I.

The Chemical Electric Company, Inc., of Rochester, N. Y., has filed articles of incorporation, with a capital stock of $60,000, for the purpose of manufacturing chemical electric batteries. The incorporators are: J. C. Schefler, 159 Rugby Avenue, Rochester; H. E. Evans and H. J. Wood, 1358 Main Street, Buffalo, N. Y.

The Hartland Power Company of New York, N. Y., has been incorporated, with a capital stock of $700,000, by John B. Hart, Osman E. Swartz, E. B. Templeman, R. O. Fallon and W. G. Strathers, all of New York, N. Y. The company proposes to generate and transmit energy for public use from water, steam or gas. The chief works of the company will be located at Hartland, W. Va.

The International Power Company of Anaconda, Mont., has been incorporated, with a capital stock of $5,000,000, for the purpose of developing additional water power in the State of Montana. Among the directors are C. F. Kelley and Eugene Carroll, both connected with the Anaconda Copper Mining Company.

The Commonwealth Light & Power Company of Baltimore, Md., has been incorporated, with a capital stock of $11,000,000, for the purpose of acquiring, building and operating electric-light and power plants, water works, gas plants and storage and ice-manufacturing plants. The incorporators are: John C. Jackson and Roger Sherman, both of 30 Pine Street, N. Y., and George R. Gaither of Baltimore, Md.

The Prairie Light & Development Company of Little Rock, Ark., has been chartered, with a capital stock of $500,000, for the purpose of constructing electric distributing systems and transmitting electricity (to be purchased) for operating cotton gins, rice mills and rice pumping plants. The incorporators are: S. R. Morgan of Little Rock, Ark., J. R. Perkins of St. Louis, Mo., and R. O. Lehn of Chicago, Ill.

Trade Publications

Flexible Shafting. — The Stow Manufacturing Company has issued Bulletin No. 102 descriptive of Stow flexible shafting.

Tea Kettle.—The latest Hotpoint device, an electric tea kettle, is described to the trade in a small folder, form 1437-15-1116.

Steam and Oil Separators.—A small booklet describing steam and oil separators has been issued by the Austin Separator Company, Detroit, Mich.

Skip Hoist.—R. H. Beaumont Company, Philadelphia, Pa., describes in Catalog No. 32 the application of its skip hoist to ash handling.

Incandescent Lamps.—In a statement to buyers the Westinghouse Lamp Company shows graphically the remarkable increase in the production of Westinghouse Mazda lamps.

Reflectors.—Bulletin No. 60 issued by the Central Electric Company contains information regarding the Moxolite reflector for shops, freight sheds, warehouses, terminals, factories, roundhouses, docks and yards.

Transformation Point Apparatus.—In bulletin 866-A The Leeds & Northrup Company, Philadelphia, Pa., describes apparatus for the location of thermal transformation points—critical points, recalescence points, and decalescence points.

Protective Devices.—Metropolitan Engineering Company, New York, has printed the sheets for insertion in the Electrical Salesman's Handbook, issued by the Commercial Section of the National Electric Light Association, descriptive of its protective devices and other central station specialties.

Heating Devices.—C-H electric dryers for beer vats, C-H electric industrial stoves, C-H circulation type water heaters, C-H electric plate warmers, C-H immersion type water heaters and C-H electric glue pots are described in six small envelope inclosures just issued by the Cutler-Hammer Manufacturing Company of Milwaukee. Uniformly distributed and accurately controlled heat, which is not affected by drafts of air, and a heater without dirt, soot or ashes, and which does not vitiate the air or overheat the room are some of the advantages of the electric devices over the gas and oil appliances which they replace. Illustrations in the several folders show the devices separately and also installed in service.

Electric Irons.—Three four-page envelope inclosures have just been published by the Cutler-Hammer Manufacturing Company of Milwaukee, describing C-H electric laundry irons, C-H electric tailors' irons and C-H electric soldering irons respectively. The folder concerning laundry irons lists irons of two weights most convenient for domestic use. The inclosure describing tailors' irons lists irons of heavier weights designed by the manufacturers for the more severe service for which the tailor uses an iron. The folder describing electric soldering irons points to the economy, quick-heating qualities, and the ability to maintain a constant or varying heat as several of the more important advantages.

New England

BANGOR, ME.—The Western Union Telegraph Company is planning to install underground conduits in the business section of the city in the spring.

LIMERICK, ME.—The stockholders of the Limerick Water & Electric Company have voted to change the name of the company to the Western Maine Power Company.

MILL VILLAGE, N. H.—The Glenn Mill, a grist mill, saw mill and entire water rights, together with storage facilities on East Creek, in Mill Village, owned by W. C. Leonard, have been purchased by the F. R. Patch Manufacturing Company.

FALL RIVER, MASS.—The Fall River Electric Light Company has applied to the Commission on Waterways and Public Lands, Commonwealth of Massachusetts, for permission to drive piles, build concrete foundations or piers and erect towers and wires for the transmission of electricity in and over the tide waters of Taunton Great River in the city of Fall River and the town of Somerset.

LENOX, MASS.—The Selectmen are considering a proposal submitted by the Lenox Electric Company to substitute electric lamps for gasoline lamps in New Lenox. The company has also submitted a proposition to install a motor installation at the pumping plant to replace the steam-driven machinery.

PLYMOUTH, MASS. — The Plymouth Electric Light Company has applied to the Massachusetts Gas and Electric Light Commissioners for permission to issue $130,000 in capital stock.

SPRINGFIELD, MASS.—The general contract for the new factory for the Bozart Rug Company, to be erected on Plainfield Street, has been awarded to Fred T. Ley & Company of Springfield. The building will be 64 ft. by 310 ft., equipped with elevators, steam heat, electric lights, etc. A power plant will be erected in the rear. The cost of building is estimated at $75,000.

WATERTOWN, MASS.—Arrangements have been made by the Selectmen with the Edison Electric Illuminating Company of Boston whereby the street-lighting service will be greatly improved. It is proposed to change the style of lamps now in use.

WORCESTER, MASS.—The extension of the luminous arc-lamp lighting system through Shrewsbury Street to the Square, on Shamrock, Cross and East Central Streets is recommended in the annual report of superintendent Henry A. Knight to the City Council. A new type of lamp is recommended for the entire length of Water Street, in parts of Harlem Street, Commercial, Portland, Pleasant and Elm Streets.

NEW HAVEN, CONN.—The directors of the United Illuminating Company has increased its capital stock by $825,000, the proceeds to be used for the development of its plants in New Haven and Bridgeport.

NORWICH, CONN.—Application will be made to the next Legislature by the Shore Line Electric Railway Company of Norwich for permission to purchase the street railway lines of the Norwich & Westerly, the Groton & Stonington and the New London & East Lyme Street Railway Companies. It also will ask for authority to transmit electricity for any company chartered to generate and sell electricity over any of the lines it has or may have for railway, manufacturing or lighting purposes.

Middle Atlantic

ALBANY, N. Y.—The Municipal Gas Company is erecting a large electric light plant in Albany.

HORNELL, N. Y.—The installation of a new street-lighting system in Hornell is under consideration. It is proposed to replace the arc lamps now in use with more modern lamps.

LITTLE FALLS, N. Y.—Steps have been taken to secure a new street lighting system for the city of Little Falls. Electrical service is furnished by the Utica (N. Y.) Gas & Electric Company.

NIAGARA FALLS, N. Y.—The Niagara River & Eastern Railway Company has decided to renew its application to the Public Service Commission for permission to construct a double-track electric railway from Lockport to the Devil's Hole, near Niagara Falls, N. Y.

OVID, N. Y.—The Ovid Electric Company, which supplies electricity in Ovid, Trumansburg and Interlaken, expects to entirely rebuild its transmission lines next summer. The company's plant is located at Taughannock Falls.

ROCHESTER, N. Y.—Plans are being considered by the Main Street East Improvement Association for the installation of an ornamental lighting system in that district.

SODUS CENTER, N. Y.—The residents of Sodus Center have petitioned the Town Board to establish a lighting district in the village and to enter into a contract with the Northern Wayne Electric Light & Power Company, of Wolcott, for lighting the streets for a period of five years.

WALDEN, N. Y.—The Wallkill Valley Light & Power Company has applied to the Public Service Commission for permission to exercise a franchise in the towns of Montgomery and Crawford in Orange County.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., has submitted a proposition to the City Council offering to lease for a period of 99 years the water power on Black River just above Watertown, owned by the city. The company stipulates that the city shall complete the power development begun at the pumping station about six years ago, which now lacks little except the construction of a power house for completion; also to install two 1500-hp. wheels within one year. On its part the company agrees to equip one wheel with generator at once and the other within one year. Under the terms submitted the company would pay the city for all power generated at a rate of $10 per horsepower. It is estimated that the city would receive about $45,000 per year.

HANOVER, PA.—The Hanover Light, Heat & Power Company and the Hanover, McSherrystown Street Railway Company will be operated by the Keystone Utilities Company of Scranton. The company will also take over the Gettysburg Electric Company.

HARRISBURG, PA.—Ground has been broken for the erection of the new electric storage battery laboratory of the Front-Market Motor Supply Company. The new building will be erected in the rear of the company's store.

NEW BRIGHTON, PA.—Bids will be received by the light committee of the Borough Council of New Brighton until Jan. 25, 1917, for new street-lighting system and furnishing electric current. For details see proposal columns.

PALO ALTO, PA.—Contract has been awarded to the J. G. White Engineering Corporation, 43 Exchange Place, New York City, by the Eastern Pennsylvania Light, Heat & Power Company for the engineering and construction work in connection with extensions and improvements to its plant at Palo Alto as follows: For the installation of a 7500-kw. turbo-generator and transformers of 3000 kva. capacity, together with condensers, auxiliaries and necessary switching equipment; an additional 500-kw rotary with transformers for railway service, and the installation of superheaters on all boilers. The addition of the above turbine will necessitate the construction of a cooling pond to provide condenser water. Extensive alterations and extensions will be made to the present power house.

PHILADELPHIA, PA.—The Philadelphia Electric Company has purchased two plots of land on Bertram Avenue to be used for sites for electric plants (to be erected in the future), in connection with the proposed extension of its system to Chester and other places.

TUNNELTON, PA.—Plans are being prepared by the Bessemer Coal & Coke Company for the erection of a substation, 44 ft. by 101 ft., one story, in Tunnelton. The Randolph Means Company, Oliver Building, Pittsburgh, has charge of the engineering work.

MAPLEWOOD, N. J.—Specifications for the installation of a police telegraph system have been approved by the township committee.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has received authority from the Public Service Commission to issue $900,000 in bonds, the proceeds to be used for extensions and improvements.

LONACONING, MD.—The Lonaconing Glass Company is planning to rebuild its plant, recently destroyed by fire. The plans provide for the installation of electric generators. James Love is president.

BLUEFIELD, W. VA.—The Appalachian Power Company contemplates extending its electric transmission lines from Saltville to Clinchfield, Va., a distance of 25 miles.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

PRINCETON, W. VA.—Application has been made to the Council by A. W. Hecker, of Pittsburgh, Pa., and H. E. De Jaenette, of Princeton, for a franchise to construct a car line, 6 miles long, to be operated by either steam, electricity or horse-power, from Princeton to Athens.

WHEELING, W. VA.—The Standard House Company, recently incorporated, with a capital stock of $10,000, proposes to construct a model village, equipped with electric-lighting, water and sewerage systems. The proposed village will be located near the property of the Standard Coal Company in Brooke County. H. C. Wells, H. B. Lockwood and others of Wheeling are interested.

FRANKLIN, VA.—The City Council is contemplating issuing $40,000 in bonds for improvements to the municipal electric-light and water-works systems.

HAMPTON, VA.—The War Department has selected a site on Back River, 1¾ miles from Hampton, for the proposed army aviation school and experimental station; will utilize 1669 acres purchased at $290,000; contract will soon be awarded for buildings, to cost about $1,500,000. The Newport News & Hampton Railway, Gas & Electric Company and the Chesapeake & Ohio Railway Company will operate dual railway system, costing about $90,000, to be built, connecting Hampton with the site.

NORFOLK, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 22, 1917, for an electric-lighting and power system for the structural shop at the navy yard, Norfolk.

NORFOLK, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 2, 1917, for furnishing two 300-kw. motor generator sets and switchboard at the navy yard, Norfolk, Va. Specifications may be obtained upon application to the above bureau or to the commandant of the navy yard named.

WASHINGTON, D. C.—The Public Utilities Commission has authorized the extension of the lines of the Capitol Traction Company to afford transportation facilities to the government buildings, now completed and under construction, south of Pennsylvania Avenue and west of Seventeenth Street. The cost of the work is estimated at $100,000.

WASHINGTON, D. C.—Bids will be received at the office of the secretary of board of commissioners, Room 509, District Building, Washington, D. C., until Jan. 4 for furnishing and installing a filtering and sterilizing system for the swimming pool at the Dunbar High School, No. 174, located at First and N Streets, Northwest, by the ultra violet ray process. Specifications, etc., may be obtained from the chief clerk, Engineering Department, Room 427, District Building.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 548—one marine oil-burning furnace, one motor-driven pressure blower, one 16-in. high-speed drill, one 30-in. radial drill, one each 14-in. and 16-in. engine lathes, one patternmaker's lathe, 14 in. by 56 in., one screw-cutting lathe, two 26-in. turret lathes, one milling machine. Boston, Mass., Schedule 507—refrigerating system; Schedule 547—miscellaneous water-tight annunciators, miscellaneous ammeters, voltmeters, etc., two turbo-generating sets, miscellaneous electrical supplies; Schedule 551—furnishing and installing exhaust system. Philadelphia, Pa., Schedule 515—15 power boat bells, 60 electricians' tool kits; Schedule 554—three each motor and controller ventilating sets; Schedule 516—7000 ft. galvanized steel conduit pipe; Schedule 545—one printing, washing and drying machine. Charleston, S. C.—Schedule 556—miscellaneous copper pipe, miscellaneous pipe and tubing steel, 288 lb. brass tubes. Newport, R. I. Schedule 553—4000 lb. copper tubing. Puget Sound, Wash., Schedule 526—1000 interior fittings for water-tight switches, 1200 lamp sockets; Schedule 525—5 miscellaneous pipe fittings; Schedule 521—10,000 ft. galvanized welded steel pipe, 1000 ft. aluminum voice tubing, 96 galvanized malleable-iron unions. Norfolk, Va., Schedule 516—10,000 lb. brass tubing. Application for proposal blanks should designate the schedule desired by number.

North Central

AKRON, OHIO.—The Northern Ohio Traction & Light Company has petitioned the Public Utilities Commission for authority to issue $1,000,000 in capital stock, extensive improvements are contemplated by the company, including the erection of

a traction terminal building, the purchase of new cars for the Akron and Canton service, new electrical equipment for the interurban cars and extensions of service in both Akron and in Canton.

BATAVIA, OHIO.—Plans are being considered by the Board of Public Affairs for the installation of an ornamental lighting system in the business district.

BLUFFTON, OHIO.—The Western Ohio Railway Company of Lima has submitted a proposal to the Council offering to supply energy to operate the municipal electric-lighting system at 2 cents per kw.-hour.

CAMBRIDGE, OHIO.—The Public Utilities Commission has authorized the Ohio Service Company to issue $154,000 in capital stock and $118,000 in bonds. Of the proceeds $118,992 is to pay for extensions and improvements.

CINCINNATI, OHIO.—The Ohio Gas & Electric Company has applied to the County Commissioners for a franchise to erect electric transmission lines from the Hamilton County line to Middletown. This is part of the plan to transmit electricity from Cincinnati to Hamilton and Middletown.

CLEVELAND, OHIO.—An ordinance authorizing the expenditure of $112,500 for the purchase of a turbo-generator for the light and heat depatment of the Department of Public Utilities has been approved by the Council.

CLEVELAND, OHIO—The Cleveland, Akron & Terminal Railway Company of Cleveland contemplates the construction of an electrically operated subway under East Fifty-fifth Street. O. C. Barber of Barberton is interested.

CLEVELAND, OHIO.—Commissioner of Light Davis has asked the Board of Control for authority to expend $44,950 for a new boiler for the municipal light plant, to enable the electric plant to furnish steam to the city water division.

COLUMBUS, OHIO.—Plans are being considered by the Chamber of Commerce for the erection of a factory power building in Columbus to accommodate light manufacturing concerns.

DAYTON, OHIO.—The Recording & Computing Machine Company, it is reported, contemplates the construction of an electric railway from the center of the city to its plant.

LOCKWOOD, OHIO.—The Cleveland & Sharon Rapid Transit Company has petitioned the Ohio Public Utilities Commission for permission to issue $100,000 in capital stock and $20,000 in bonds for construction of an electric railway from Middlefield to Lockwood. C. A. Black, of Cleveland, is president.

MASSILLON, OHIO.—The Northern Ohio Traction & Light Company of Akron, it is reported, contemplates the construction of a carhouse and substation on the site of the carhouse recently destroyed at Massillon.

MASSILLON, OHIO.—The Massillon Electric & Gas Company has been awarded the contract for street-lighting for a period of ten years. The new contract provides for an ornamental lighting system in the business section and arc lamps will be replaced with incandescent lamps.

MECHANICSBURG, OHIO.—The North Western Ohio Light Company of Van Wert has applied to the State Utility Commission for permission to acquire the property of the Mechanicsburg Light & Power Company. The North Western company already has erected a transmission line to the Mechanicsburg line, but has never furnished power to the east end of the town.

ROCKY RIVER, OHIO.—The Public Utilities Commission has authorized the sale of the property of the Rocky River Water, Light & Power Company to the Cleveland (Ohio) Electric Illuminating Company, for $4,000.

WARREN, OHIO.—The Youngstown & Niles Railway Company has secured most of the right of way between Niles and Youngstown for its proposed new electric railway to connect the two cities. It is understood that the line will eventually extend to Warren.

YOUNGSTOWN, OHIO.—Extensions and improvements, to cost about $300,000, are contemplated by the Bell Telephone Company to its local system. The work will include cable, conduit, overhead wiring, etc.

YOUNGSTOWN, OHIO.—The Mahoning & Shenango Railway & Light Company contemplates the installation of automatic block signals on 12 miles of single track and 3 miles double track between Youngstown, Ohio, and Sharon, Pa.

ASHLAND, KY.—The Boyd County Electric Company of Ashland has increased its capital stock from $32,000 to $155,000.

LEXINGTON, KY.—Negotiations are under way between the City Commissioners and the City Council for the installation of a new street-lighting system.

BROWNSTOWN, IND.—The Jackson County Transmission Company, recently incorporated, proposes to supply electricity in Brownstown and vicinity. The company is capitalized at $15,000. E. F. Reason, F. G. White and others are interested.

FORT WAYNE, IND.—Three new substations are being erected by the Fort Wayne & Northern Indiana Traction Company, between Fort Wayne and Decatur; one being located just south of Fort Wayne, one half way between the two terminals and the third just outside of the city limits of Decatur, near the power house.

HOPE, IND.—The Board of Trustees has awarded Messrs. Pulse & Porter, owners of the local electric-light plant, a contract for lighting the streets of the town. Under the terms of the new contract the 20 arc lamps now in use will be replaced with four 400-watt Mazda nitrogen-filled incandescent lamps at $75 each per year, and 41 nitrogen-filled incandescent Mazda lamps at $25 each per year.

SALEM, IND.—The local electric plant of the Interstate Public Service Company of Indianapolis was recently destroyed by fire.

AVERYVILLE, ILL.—The Village Council has granted the Peoria & Chillicothe Electric Railway Company a franchise to construct and operate an electric railway in Averyville.

CULLOM, ILL.—The Cullom Electric Company, recently incorporated, has been granted permission by the Public Utility Commission to conduct an electric utility business. Arthur G. Walter is secretary and treasurer.

GENOA, ILL.—The Woodstock & Sycamore Traction Company of Genoa, which operates a railway between Sycamore, Genoa and Marengo, a distance of 25 miles, contemplates equipping its road for electrical operation during the coming spring. Cars are now operated by gasoline.

MOMENCE, ILL.—Plans are being considered by the Commercial Club for the installation of an ornamental street-lighting system.

PEORIA, ILL.—Application has been made to the Public Utilities Commission by the Illinois Traction System, operating under the name of the Consumers' Electric Company, for permission to supply electricity in the village of Dawson.

SPRINGFIELD, ILL.—The City Council is considering the question of requiring all electric wires in the business district to be placed underground.

EDEN, WIS.—The Wisconsin Gas & Electric Company of Kenosha has purchased the property of the Eden Electric Light & Power Company and will take possession Jan. 1, 1917. The Wisconsin company has secured a franchise to extend its transmission lines to Marblehead where it will supply electricity for industrial purposes.

KNAPP, WIS.—Plans are being considered for the installation of an electric-light plant in Knapp. L. Teegarden is interested.

MERRILL, WIS.—The City Council has adopted a plan submitted by A. J. Sweet, consulting engineer of Milwaukee, for an ornamental street lighting system. It is proposed to use concrete standards mounted with nitrogen-filled incandescent lamps.

RANDOM LAKE, WIS.—The village of Random Lake is considering issuing bonds for the installation of a municipal lighting plant.

STOUGHTON, WIS.—Steps have been taken to organize a company to provide electrical service in the suburbs of Stoughton. Walter Hinge and others are interested.

WONEWOC, WIS.—The Village Board has entered into a contract with Arthur E. Gale of Wonewoc, under which the latter will furnish a 24-hour service here. Mr. Gale contemplates the construction of a hydroelectric plant.

BROOK PARK, MINN.—The installation of an electric-lighting system in Brook Park is under consideration. R. P. Allen, of Pine City, manager of the Eastern Minnesota Power Company, is interested.

MINNEAPOLIS, MINN.—Extensive improvements in the Twin Cities during 1917, involving an expenditure of about $5,000,000, are contemplated by the Northwestern Telephone Exchange Company. C. E. Yost is president.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company is contemplating the construction of a building, 200 ft. by 375 ft., at Chestnut Avenue and Sixteenth Street, to cost about $500,000. The building will be used as a substation, for storage purposes and repair shop.

MOUNTAIN IRON, MINN.—The Village Council has entered into a contract with the Great Northern Power Company of Duluth for electrical service in Mountain Iron. The company will soon begin work on the extension of its line to Mountain Iron.

WABASHA, MINN.—The Wisconsin-Minnesota Light & Power Company of Eau Claire is contemplating the erection of a substation in Wabasha.

CENTERVILLE, IOWA.—The Iowa Southern Utilities Company, it is reported, contemplates rebuilding its power plant in Centerville, increasing the output from 2000 to 5000 hp. F. S. Payne and D. C. Bradley of Centerville are interested in the company.

COUNCIL BLUFFS, IOWA.—Plans are being considered for the installation of an ornamental lighting system in the business district. Several sample lamps have been erected by the Citizens Gas & Electric Company for experimental purposes.

DES MOINES, IOWA.—The contract for the electric wiring for the assembly plant of the Ford Motor Company, at Eighteenth and Grand Streets, Des Moines (to cost $600,000) has been awarded to L. K. Comstock & Company, 30 North Michigan Avenue, Chicago, Ill. Contracts for elevators, heating and plumbing have not yet been awarded. Albert Kahn, 58 Lafayette Boulevard, Detroit, Mich., is architect.

LANESBORO, IOWA.—The local electric plant, owned by J. R. Davis, was recently destroyed by fire.

OELWEIN, IOWA.—The Fayette County Utilities Company has submitted a proposal to the City Council offering to pump the city water from the present water-works plant to the present stand-pipe or any other stand-pipe or reservoir which may hereafter be built for a period of from five to ten years. The proposal provides that all electrically-driven equipment shall be furnished in duplicate and installed at the expense of the city of Oelwein.

OSKALOOSA, IOWA.—Plans are being prepared by A. T. Simmons, First National Bank Building, Bloomington, Ill., for a heating plant for Penn College, including heating system, power plant, smoke stack, 125 ft. high; second floor to be used for manual training. Dean S. M. Bradley is chairman of building committee.

PACKWOOD, IOWA.—The Council is considering the question of granting the Iowa Gas & Electric Company a franchise to supply electrical service in Packard.

SIOUX CITY, IOWA.—Armour & Company are asking for bids for construction of a sheep killing and oleo building, in Sioux City, to cost about $200,000. Separate bids will be received on cork insulation, electric wiring, elevators and overhead tracking. U. G. Graham is master mechanic; R. G. Clark of Chicago, Ill., is architect.

SPENCER, IOWA.—Bids for bond issue of $50,000 for proposed light and power plant have been returned unopened. New bids, it is understood, will be asked for later.

HIGBEE, MO.—The property of the Citizens Electric Light Company has been purchased by the Moberly (Mo.) Light & Power Company. Energy for operating the local service will be supplied from the Moberly plant. A 24-hour service will be established.

MOUNT VERNON, MO.—Plans are being prepared by the C. Moore Engineering Company, Frisco Building, Joplin, Mo., for an electric-light plant, to replace the one destroyed by fire. The cost is estimated at $10,000.

NEWTON, MO.—The City Council contemplates calling an election to submit to the voters the proposal to issue bonds for the construction of a municipal electric-light plant.

GWINNER, N. D.—A company has been organized by local business to construct and operate an electric-light plant in Gwinner.

NAPOLEON, N. D.—The Napoleon Light & Power Company, recently incorporated with a capital stock of $15,000, proposes to establish an electric light and power plant in Napoleon. W. M. Noddings, E. A. Wellan, and others, of Napoleon, are interested in the company.

DELL RAPIDS, S. D.—Bonds to the amount of $40,000 have been voted for the installation of an electric-light plant.

GILTNER, NEB.—The municipal electric-light and power plant was recently damaged by fire, causing a loss of about $5,000.

OMAHA, NEB.—Plans are being prepared for the construction of a telephone exchange building, 132 ft. by 66 ft., fifteen stories, for the Nebraska Telephone Company, in Omaha. George B. Prinz, Omaha National Bank Building, Omaha, Neb., is architect.

WAKEFIELD, NEB.—The plant and holdings of the Wakefield Electric Light Company have been purchased by S. B. Knudson of Hartington. The local plant, it is understood, will be one of a number in this section to be operated from a central station.

WINSIDE, NEB.—The proposal to issue $7,500 in bonds for the installation of an electric-lighting system will be submitted to the voters.

CALDWELL, KAN.—At an election to be held Jan. 23 the proposal to issue $80,000 in bonds for improvements to the municipal electric-light plant and water-works system will be submitted to the voters. The plans provide for the installation of two turbine-driven generators of 200 kva. each, two motor-driven centrifugal pumps of 750 gal. per minute capacity each. Layne & Bower of Memphis, Tenn., have the contract for wells, etc. Contracts for electrical equipment and work will not be awarded until after the election. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are consulting engineers. H. W. Barker is city clerk.

WHITE CITY, KAN.—Plans are being considered for improvements to the local electric-light plant, owned by O. H. Nelson, which include the purchase of a 10 or 15-hp. gas engine and an alternating-current generator.

Southern States

DURHAM, N. C.—Work has begun on the extension of the power plant of the Durham Traction Company on Vivian Street, which will involve an expenditure of about $30,000. The work will include an addition to power house, 100 ft. by 35 ft., and erection of smokestack, 175 ft. high. A new 500-hp. boiler will be installed and orders have been placed for a 2000-kw. steam turbine.

PENLAND, N. C.—The Penland Clay Company, recently incorporated, for the purpose of mining kaolin, feldspar and mica, is planning to equip its plant and will install clay-washing machinery, generators, boilers, engines, hoisting outfits, dump cars, etc. Harry Bailey is interested in the company.

CHARLESTON, S. C.—The City Council has voted to purchase the plant of the Charleston Light & Water Company, at $1,360,000. The proposition to buy the property will be submitted to the voters.

GREENSBORO, GA.—The installation of an electric light plant in Greensboro is under consideration.

PANAMA PARK, FLA.—Steps have been taken by the residents of Panama Park to install an electric-light plant.

VERO, FLA.—The Vero Electric Light & Ice Company, recently organized by N. J. Norman and others, contemplates the construction of an electric-light plant and ice factory in Vero.

RUGBY, TENN.—The Memphis & Rugby Railroad Company, it is reported, contemplates the installation of an electric plant in Rugby Park.

RUGBY, TENN.—The Memphis & Rugby Railway Company of Memphis has awarded contract for erection of power house to L. B. Moody of Memphis, at $3,500. The work will also include the erection of 2 miles of transmission line to connect Memphis and Rugby. About 40 hp. will be developed. The total cost of plant is estimated at $10,000. H. G. Ferree is engineer.

MONTGOMERY, ALA.—Extensive improvements are contemplated by the Montgomery Light & Water Power Company, involving an expenditure of about $125,000. The work will include changing two of the four generating units at the Tallassee dam, increasing the output by 2000 kw.; the erection of a new substation in the heart of the manufacturing district in North Montgomery; re-arranging the distribution system in the city proper, the installation of additional transformers, switchboards, etc. Contracts, it is understood, have been placed for machinery and equipment. F. W. Frueauff is vice-president and general manager.

EARLE, ARK.—The plant of the Earle Light, Power & Ice Company was recently destroyed by fire, leaving the town without electrical service. Orders, it is understood, have been placed for new machinery.

CROWDER, OKLA.—The installation of a municipal electric-light plant in Crowder is under consideration.

FORGAN, OKLA.—Contract, it is reported, has been awarded to E. M. Gant, Oklahoma City, for the installation of a municipal electric-light plant.

KAW CITY, OKLA.—The City Council is considering the installation of an electric-light plant and water-works system.

MIAMI, OKLA.—The city of Miami is reported to have sold $25,000 in bonds, the proceeds to be used for installation of an electric-light plant and water-works system.

NEW WILSON, OKLA.—At an election to be held Jan. 5 the proposal to issue $10,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters.

NORMAN, OKLA.—The Council is considering the installation of a municipal electric-light plant.

RINGLING, OKLA.—Preliminary plans are being prepared by the Mackintosh-Walton Company, State Bank Building, Oklahoma City, for the construction of a municipal electric-light plant, to cost from $10,000 to $25,000. Bonds are yet to be voted.

STROUD, OKLA.—Improvements are contemplated to the municipal electric-light plant and water-works system. The Benham Engineering Company, Colcord Building, Oklahoma City, has charge of the engineering work.

TULSA, OKLA.—The contract for electric wiring of the Palace Office Building has been awarded to the Electric Contracting Company of Tulsa. The cost of the building is estimated at $80,000.

AUSTIN, TEX.—The contract for electrical work for the land-office building has been awarded to Wright Brothers of San Antonio, at $24,825.

BOWIE, TEX.—At an election held recently the proposal to purchase the local electric-light plant was carried. Improvements will be made to the system.

BROWNWOOD, TEX.—The Texas Power & Light Company contemplates increasing the output of its local plant for the purpose of supplying electricity in various cities in this vicinity. Larger engines will be installed, and, it is reported, the transmission lines will be extended to Stephenville and Dublin. W. P. Murphy is local manager.

DALLAS, TEX.—The City Council is considering the installation of an electric-lighting system in West Dallas.

GREENVILLE, TEX.—The proposal to sell the municipal electric-light and power plant to the Texas Power & Light Company of Dallas will soon be submitted to the voters.

HOUSTON, TEX.—Application has been made for a permit for the erection of an engine room and power house for the Baptist Sanitarium, to cost about $8,000.

MABANK, TEX.—The Council is considering the installation of an electric-lighting system in Mabank.

MART, TEX.—The City Commission has granted the Mutual Electric Company a franchise to construct and operate an electric-light plant in Mart. Lee Harlan is reported interested in the company.

SAN ANGELO, TEX.—Arrangements have been made by C. C. McBurnett, who is erecting a new hotel in San Angelo, at a cost of $150,000, to install a private power plant, which will supply electricity for lamps and motors in the building.

Pacific States

BELLINGHAM, WASH.—The Morrison Lumber Company is contemplating remodeling its entire plant, substituting electricity for steam power. Allis-Chalmers equipment will be used.

BELLINGHAM, WASH.—The Earles-Cleary Lumber & Shingle Company is installing complete electrical equipment to replace steam power at its works. The company will generate its own electricity. Allis-Chalmers equipment will be used throughout. The cost is estimated at about $20,000. Michael Earles is manager.

CHEHALIS, WASH.—The citizens of Centralia, Chehalis and other towns along the route of the Pacific Highway have taken up the proposal to install a lighting system on the highway the entire length of Lewis County with the County Commissioners.

CLARKSTON, WASH.—The Washington-Idaho Water, Light & Power Company, which recently took over the property of the Lewiston-Clarkston Improvement Company, it is reported, contemplates the construction of a dam in the Snake River at a point 3 miles below Lewiston and Clarkston, to develop about 50,000 hp.

EVERETT, WASH.—The Ferry-Baker Lumber Company has awarded a contract to A. H. Cox & Company of Seattle for reconstruction of power plant, substituting electricity for steam power throughout, at a cost of about $50,000. General Electric equipment will be used.

INDEX, WASH.—The City Council has authorized a special election to vote on the proposal to issue bonds for the installation of a municipal electric-light plant. The Coast Engineering Company of Seattle has been engaged to prepare and submit an estimate of the cost of the proposed plant to the Council before the first of the year.

NEWPORT, WASH.—The Commissioners of Pend O'Reille County have received an application from the Northern Idaho-Montana Power Company of Sandpoint for permission to erect electric transmission lines from Newport to and through Dalkena.

PE ELL, WASH.—Arrangements have been made with the Central Light & Power Company for street-lighting in Pe Ell. The city has been without street-lighting service for two years. The company has a franchise and supplies electrical service for residences, etc.

SEATTLE, WASH.—In connection with the general scheme for enlarging the municipal electric light and power plant the City Council, at a meeting held Dec. 18, passed an ordinance authorizihg an issue of $3,000,000 in bonds for the purchase of a hydroelectric plant (complete). The Board of Public Works is authorized to advertise for bids for a plant capable of generating 13,000 kw. continuous service. Several weeks ago the City Council voted to condemn property near the auxiliary steam plant at Lake Union as a site for the construction of an addition to the present steam plant.

BEND, ORE.—Preparations are being made by the Bend Water, Light & Power Company to double the output of its light and power plant and water service. The work will include the erection of a new building, new equipment, etc. The cost is estimated at about $50,000.

CHICO VECINO, CAL.—The petition asking for the formation of a lighting district in Chico Vecino has been presented to the Board of Supervisors. An election will probably soon be called to vote on the formation of the district. The proposed system will consist of about 130 lamps of 200 cp. each.

ESCONDIDO, CAL.—The San Diego (Cal.) Consolidated Gas & Electric Company which purchased the property of the Escondido Utilities Company, recently sold under foreclosure, will build a new electric transmission line from Escondido to Oceanside, connecting the properties with its main generating station at San Diego.

NOVATO, CAL.—The Novato Utilities Company has applied to the State Railroad Commission for permission to issue $25,000 in capital stock, to acquire the property of J. W. Cain and Albert Cain, who supply electricity and water and conduct a telephone and telegraph system in Novato County. The company proposes to extend the telephone, electrical and water service. J. W. Cain is president of the Novato Utilities Company.

SANTA ROSA, CAL.—Plans for the installation of an ornamental lighting system on Santa Rosa Avenue from the Burbank Home, down Main Street to the Court House, around the Court House and down Mendocino Avenue, have been presented to the Chamber of Commerce, which will submit them to the City Council. The cost is estimated at about $7,000.

ST. JOHNS, ARIZ.—The Nebo Electric Company is installing an electric power plant in St. Johns. The old grist mill at the northeast end of the town is being utilized as a power house. The plant will be operated by water power. David K. Udall is manager.

HARLEM, MONT.—The local electric-light plant, owned by R. J. Moore, has been purchased by W. L. Saul. The new owner, it is understood, contemplates extensions and improvements to the system.

Canada

VANCOUVER, B. C.—The contract for electrical work at the new freight sheds to be erected at False Creek for the Great Northern and the Northern Pacific Railway Companies, and for the installation of an entire lighting system for the Canadian Northwest Steel Company, Ltd., has been awarded to Mundy, Rowland & Company, Standard Bank Building, Vancouver.

PEMBROKE, ONT.—Plans are being prepared for the construction of a power house at Black River for the Pembroke (Ont.) Electric Light Company, to cost about $7,000. New equipment, including one generator, water wheels, etc., will be purchased.

THOROLD, ONT.—The town of Thorold contemplates the purchase of a new turbine pump and an electric motor. L. S. O'Connor is superintendent of the water-works system.

1,208,730. Motor-Generator Set; Charles J. Best, Delphos, Ohio. App. filed April 2, 1913. Use in connection with moving pictures apparatus and spot lights in theatrical work.

1,208,752. Block Signaling System for Railways; Albert V. T. Day, New Rochelle, N. Y. App. filed June 15, 1908. Normal danger systems for electric railways.

1,208,756. Electric Heating Unit; Achilles de Khotinsky, Chicago, Ill. App. filed Sept. 19, 1914. Quickly attaching the movable portions of the heating unit in good contacting relation to the circuit terminals.

1,208,775. Electric-Circuit Controller or Switch; John Hamilton, Boston, Mass. App. filed May 22, 1915. Guarantee substantial continuity of electrical service at the points of consumption.

1,208,780. Car Signalling System; William H. Heulings, Jr., Philadelphia, Pa. App. filed June 18, 1915. Suitable device for closing an electric circuit whereby a signal may be sounded in a street car.

1,208,796. Signal Device for Street Cars; George B. Kohler, Philadelphia, Pa. App. filed June 18, 1915. Improvement.

1,208,806. Means for Charging Water with Radio-Activity; Mary A. Loyer, Denver, Col. App. filed Sept. 23, 1915. Improvements in receptacles.

1,208,808. Method of Making Wall-Coverings; James W. McIndoe, Medford, and Arthur E. Whitney, Winchester, Mass. App. filed March 22, 1916. Improvements.

1,208,822. Locking Means for Internal-Combustion Motors; Casin W. Obert, Brooklyn, N. Y. App. filed Feb. 27, 1915. To make inoperative to prevent unauthorized use thereof.

1,208,817. Electric Furnace; James W. Moffatt, Toronto, Ontario, Canada. App. filed March 24, 1916. Improvements.

1,208,861. Friction-Joint; Frank H. Trimble, Los Angeles, Cal. App. filed May 1, 1916. For use with electric lamp stands which are adapted to support a lamp in any desired position.

1,208,866. Electric Switch; Fred F. Weishaar, Cleveland, and Fred W. Jackson, Elyria, Ohio. App. filed Nov. 19, 1915. For use in connection with a plurality of electric circuits.

1,208,874. Insulator; William E. Wilson, Lookout, W. Va. App. filed Aug. 19, 1916. Supporting telegraph and telephone wires, line wires and like conductors.

1,208,880. Magnetic Separator; Parvin Wright and Gordon Land, Seattle, Wash. App. filed May 26, 1913. Capable of operating with wet material.

1,208,884. Conductor for Systems of Electrical Distribution; Chauncey W. Abbott, Pittsburgh, Pa. App. filed Feb. 21, 1916. A system wherein one side of an electric circuit is constantly earthed, or grounded and is not insulated.

1,208,929. Coupling Device for Vehicles; Edward P. Doyle, Wheaton, Ill. App. filed Aug. 21, 1912. Car coupling devices.

1,208,938. Automobile-Signal; Emory D. Finch, Atlanta, N. Y. App. filed Aug. 18, 1914. Portable electric hand light.

1,208,959. Storage Battery or Housing; Ellsworth A. Hawthorne, Bridgeport, Conn. App. filed Sept. 24, 1913. Provision for conducting the acid fumes to the exterior of the casing.

1,208,961. Circuit-Controlling Device; John O. Heinze, Springfield, Ohio. App. filed Dec. 8, 1915. For controlling the lighting, ignition and starting circuits for motor vehicles.

1,208,981. Dynamo-Electric Machine; Austin Kimble, Glenellyn, Ill. App. filed May 25, 1916. Improved form of compensating winding which forms the mounting for the armature.

1,209,003. Ignition-Dynamo; Carl Thomas Mason, East Orange, N. J. App. filed Jan. 7, 1916. Eliminate the U-shaped magnets.

1,209,014. Current Connection for Electric Lamps; John Arthur Orange, Schenectady, N. Y. App. filed Dec. 26, 1914. New and useful improvements.

1,209,064. Lighting-Fixture; Merton P. Stevens, East Orange, N. J. App. filed April 22, 1915. Carried by a rigid support which is secured to a wall or ceiling.

1,209,073. Fuel-Heater for Internal-Combustion Engines; Edward S. Tesdell, Des Moines, Iowa. App. filed Feb. 28, 1916. Resistance element is in the path of fuel travel.

Record of Electrical Patents

Notes on United States Patents issued on Dec. 19, 1916.

1,209,086. Alternating-Current Motor; Hans Weichsel, St. Louis, Mo. App. filed April 12, 1915. Single-phase asynchronous induction motors having a shunt characteristic and capable of being operated at a plurality of speeds.

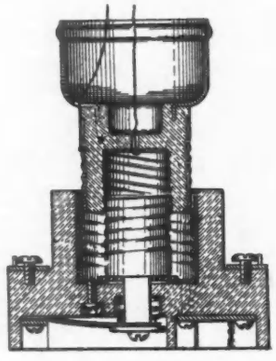
1,209,096. Conductor; Robert B. Williamson, Milwaukee, Wis. App. filed Jan. 24, 1916. Especially adapted for use in slotted cores of dynamo-electric machines.

1,209,131. Automatic Highway-Crossing Warning-Signal for Railroads; *Ben* Orlando Darrow, Sacramento, Cal. App. filed May 13, 1916. Combined visual and audible signal.

1,209,132. Machine for Subjecting Air to Violet and Ultra-Violet Rays; Noah W. Davis, Des Moines, Iowa. App. filed Jan. 11, 1916. By the passage through the air of a brush electrical discharge generated therein.

1,209,146. Selective Means for Switches; Gardner B. Gray, Pittsburgh, Pa. App. filed April 18, 1914. Switch points may be moved in opposite directions from a motor.

1,209,148. Diaphragmatic Sound-Producer; Leo Grubman, Brooklyn, N. Y. App. filed March 29, 1915. New and useful improvements.



1,209,526.—Socket for Gas Filled Tungsten Lamps

1,209,152. Lamp Attachment for Dry Cells; William A. Harvey, Scranton, Pa. App. filed March 27, 1916. Improvements.

1,209,167. Socket-Shell Cap and Insulating-Lining Therefor; Joseph Keefe, Boston, Mass. App. filed Sept. 10, 1912. A co-operating removable insulating lining for the cap.

1,209,214. Magnet-Rail for Electrical Musical Instruments; Melvin L. Severy,, Arlington Heights, Mass., and George B. Sinclair, Georgetown, Me. App. filed Jan. 4, 1913. Improved means for supporting electro-magnets.

1,209,231. Alarm-Controller; Joseph B. Tibbs, Indianapolis, Ind. App. filed Oct. 5, 1911. Controlling steam or air whistles.

1,209,234. Thermostatic Controller for Electrically-Heated Devices; Clarence Truitt, Pomona, Cal. Eliminate the subdividing of the heating element.

1,209,253. Impulse-Transmitting Device; John G. Blessing, Chicago, Ill. App. filed Jan. 9, 1913. For use in connection with automatic telephone systems.

1,209,247. Process for Manufacturing Electric Incandescence Bodies; Charles Orme Bastian, London, England. App. filed Sept. 24, 1914. In the form of very closely wound spirals suitable for use in glow lamps.

1,209,266. Repeating Coil; Hiram D. Currier, Chicago, Ill. App. filed Sept. 19, 1914. Minimize the effect of leakage lines of force.

1,209,269. Magnetic Separator; Myron Dings and Robert A. Manegold, Milwaukee, Wis. App. filed Aug. 11, 1911. New and useful improvements.

1,209,270. Vehicle-Signal; Samuel F. Douglass, Prairie Du Rocher, Ill. App. filed Feb. 13, 1914. Indicating the direction the vehicle is about to take.

1,209,279. Telephone Transmission System; William A. Fricke, Chicago, Ill. App. filed March 17, 1913. For railroad despatch work in which a plurality of stations is associated with a single line.

1,209,281. Electrical Vibratory Contact Maker and Breaker; John Gardiner, Knott End, Near Fleetwood, England. App. filed Aug. 9, 1915. For converting a continuous current.

1,209,291. Telephone Apparatus; Kenneth B. Hastings, Boston, Mass. App. filed May 15, 1915. Aiding the hearing of deaf or slightly deaf persons in public places.

1,209,293. Automatic Telephone System; Harry E. Hershey, Whitewatewater, Kan., and George A. Yanochowski, Chicago, Ill. App. filed Nov. 28, 1913. Means for releasing the switches of such a system.

1,209,298. Dry Cell; William Hoppie, Lawndale, Cal. App. filed Feb. 14, 1916. The deterioration of the cell during its "shelf life" or during the period before it is put into active service is prevented.

1,209,303. Multiple-Dial Calling Device; Alexander E. Keith, Hinsdale, Ill. App. filed June 28, 1911. Operator can complete her part in setting up the connection in a very short time.

1,209,304. Impulse-Transmitting Device; Alexander E. Keith, Hinsdale, Ill. App. filed March 3, 1913. For use by an operator in a semi-automatic telephone system.

1,209,324. Electron-Emitting Cathode and the Process of Manufacturing the Same; Alexander McLean Nicolson, New York, N. Y., and Emerson Church Hull, Montclair, N. J. App. filed Dec. 26, 1914. Greatly increased durability and constancy of activity.

1,209,332. Signaling Device for Writing or Copying Telegraphs; Alphons Rappenecker, Bremen, Germany. App. filed Oct. 27, 1913. New and useful improvements.

1,209,397. Transmitting Apparatus; John J. Comer, Chicago, Ill. App. filed Feb. 24, 1914. Wheatstone bridge principle.

1,209,403. Electric Horn; William W. Dean, Chicago, Ill. App. filed Oct. 15, 1913. Simple in construction, efficient in operation and cheap to manufacture.

1,209,407. Test System; Alfred H. Donahoe, Chicago, Ill. App. filed Oct. 16, 1915. Give answer back signals as to the condition of remotely controlled apparatus.

1,209,443. Alternating-Current Motor; Harry Wallace Jeannin, Warren, Ohio. App. filed Aug. 24, 1915. Repulsion-induction motor type.

1,209,445. Service Switch and Fuse Mechanism; John A. Jessen, Winthrop, Mass. App. filed July 16, 1914. Combination switch and thermal cutout or fuse mounted in a box or casing adapted to be closed or secured by a seal to prevent unauthorized access to the current-carrying parts.

1,209,449. Electric Rivet-Heater; William S. Johnson and John W. Sheffer, Berwick, Pa. App. filed Feb. 25, 1916. Transformer is incorporated and provided with a single secondary coil branched within itself for the individual heat treatment of a plurality of pieces of work.

1,209,478. Automatic Ringing Mechanism for Telephone Systems; Carwitt E. Myers, Ironton, Mo. App. filed Aug. 30, 1913. Automatic when a ringing key is pushed, the device will serve to effect certain current connections, for the sending of an alternating current to the sub-station, to effect the ringing of the signal.

1,209,517. Electric Regulator; Louis Willard Thompson, New York, N. Y. App. filed Feb. 26, 1915. Alternating-current voltage regulators.

1,209,518. Electric Regulator; Louis Willard Thompson, New York, N. Y. App. filed Feb. 26, 1915. Effecting momentary changes in the field of the generator.

1,209,526. Current Connection for Electric Lamps; Frederick H. Weston, Schenectady, N. Y. App. filed Dec. 26, 1914. Required by high candle power tungsten filament gas filled incandescent lamps.

1,209,533. Metal Conduit for Electric Wires; Chauncey W. Abbott, Pittsburgh, Pa. App. filed Aug. 18, 1915. For extending existing systems.

Electrical World

New York, December 30, 1916

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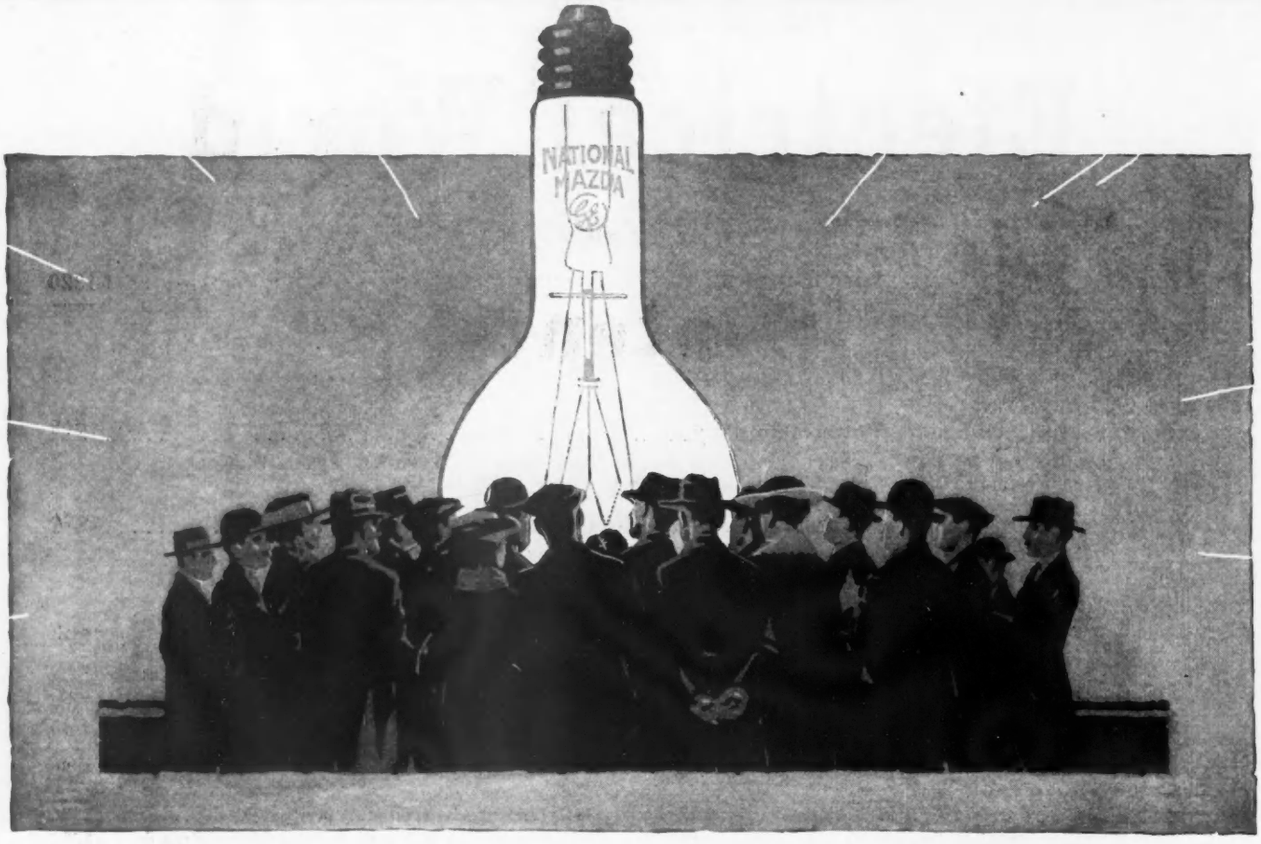

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The year's purchasing activities are now at their high water mark. Prosperity has made it easy for the merchant to light up his store. The short days make it imperative for him to do so. There has never been a better chance to interest him in sign, building front, display window and interior lighting with National MAZDA C lamps.

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NELA PARK CLEVELAND

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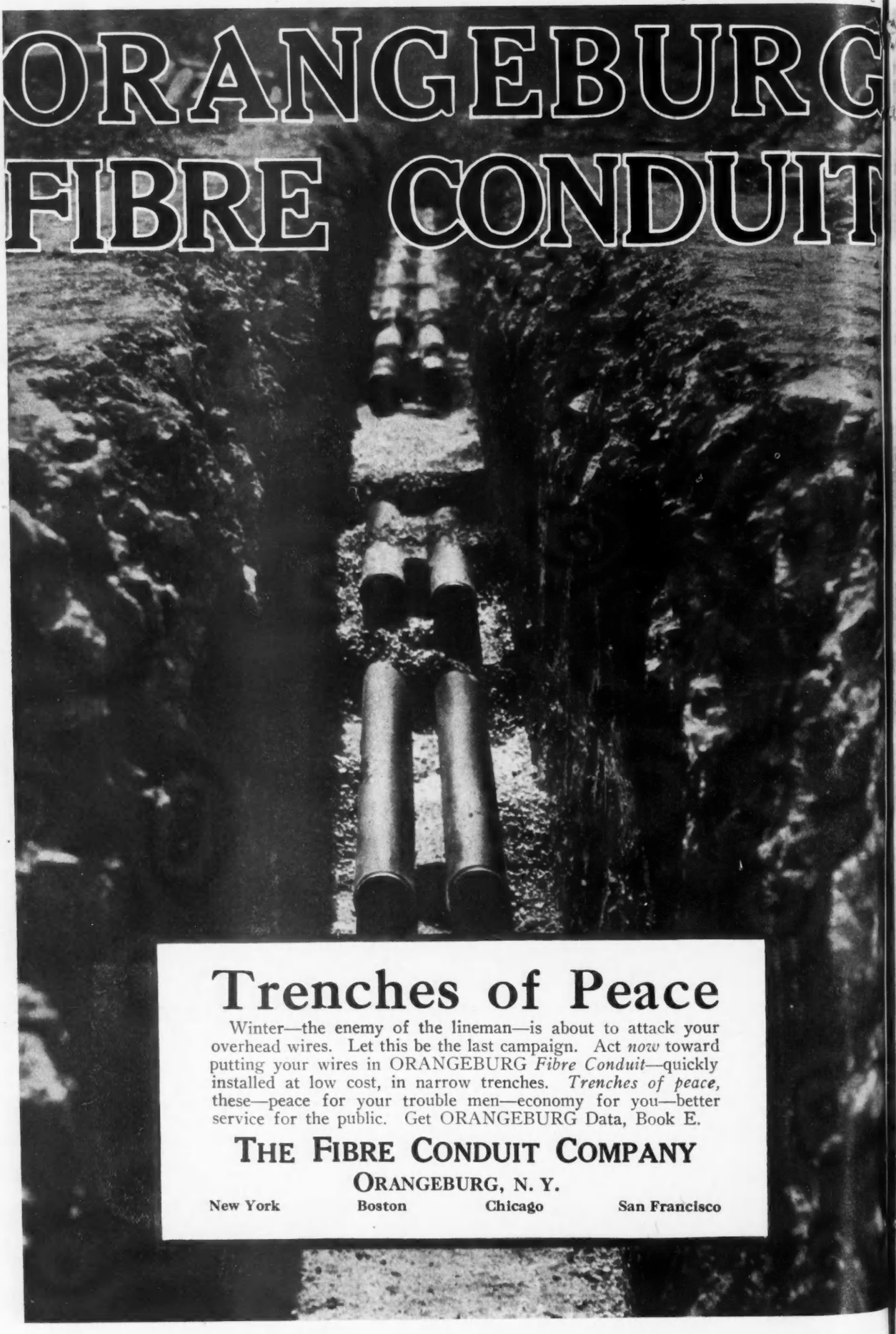
EQUIPMENT FOR EVERY ELECTRICAL NEED
Member Society for Electrical Development. "Do it Electrically"



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Winter—the enemy of the lineman—is about to attack your overhead wires. Let this be the last campaign. Act *now* toward putting your wires in ORANGEBURG *Fibre Conduit*—quickly installed at low cost, in narrow trenches. *Trenches of peace,* these—peace for your trouble men—economy for you—better service for the public. Get ORANGEBURG Data, Book E.

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After removing a bolt at top and bottom the contact fingers may be removed.

and you can lift out the contact fingers as shown in the illustration. This is a C-H feature that those experienced in crane and hoist service consider of great importance.

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FOR CRANE AND HOIST SERVICE

because of their superior rugged construction provide the most precise operation. Each speed point can be distinctly felt by the operator;—yet the operation is smooth.

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The Cutler-Hammer Mfg. Co.

Milwaukee Wisconsin

Largest Manufacturers of Motor Control Apparatus in the World

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Your Lubricating Needs

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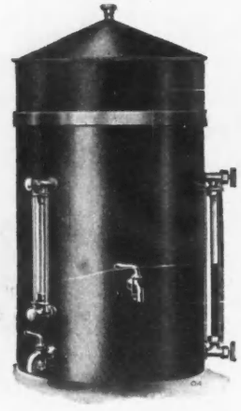
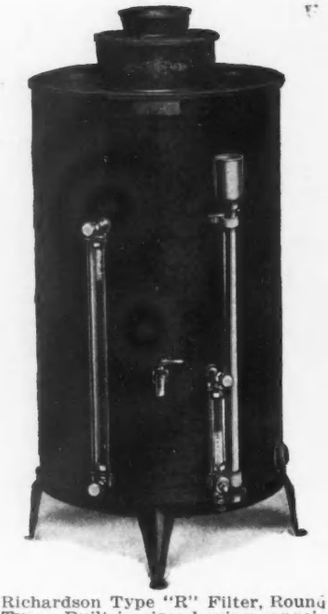
The complete line covers every power plant need. In efficiency and reliability these filters are in a class by themselves.



Richardson Type "P" Oil Filter. Portable or hand type. Built in sizes having capacities of 25-90 gallons per day.



Richardson Type "R" Filter, Round Type. Built in sizes having capacities of 65 to 90 gallons per day.

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of your plant may be you can reuse the same oil
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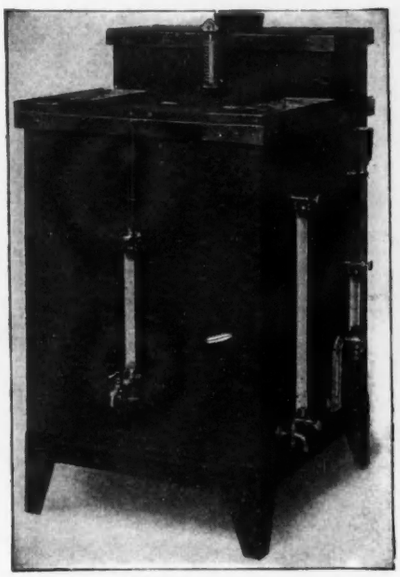
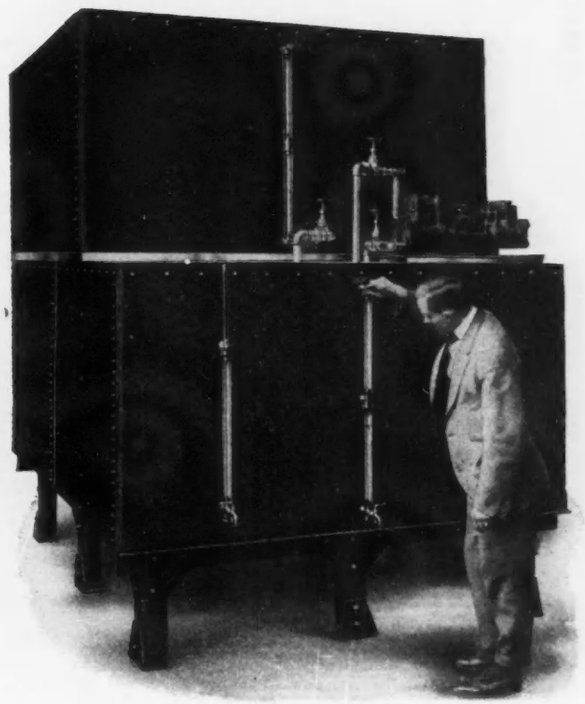


Peterson Type "A" Power Plant Oil Filter.
Built in sizes of 200 to 12,000 gallons per hour.



Peterson Type "B" Batch Oil Filter.
Built in sizes of 70 to 1500 gallons holding capacity.

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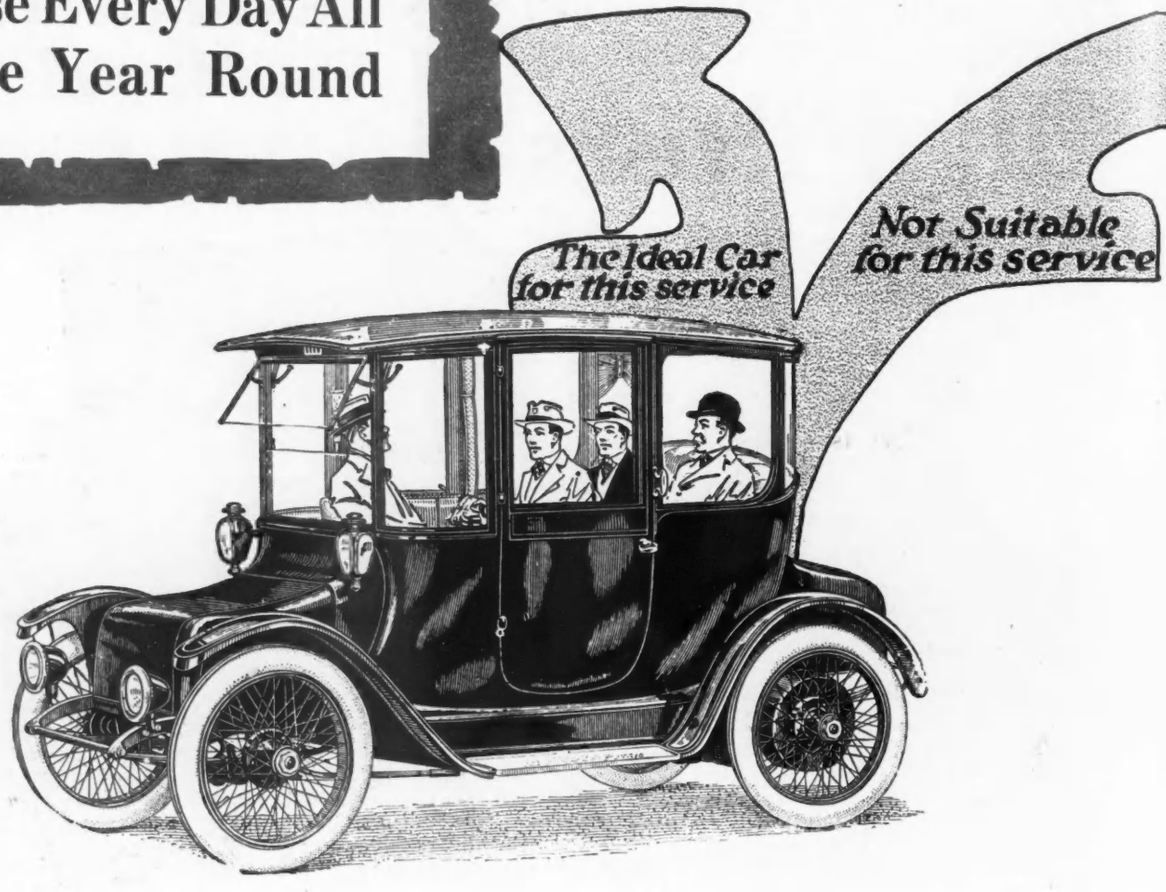

Detroit Electrics

demonstrate their superior value in the dependable day-in day-out utility and service which they furnish all the year round.

If you want to give some of your friends who drive gas cars the surprise of their lives and at the same time a striking lesson in the **utility** of Detroit

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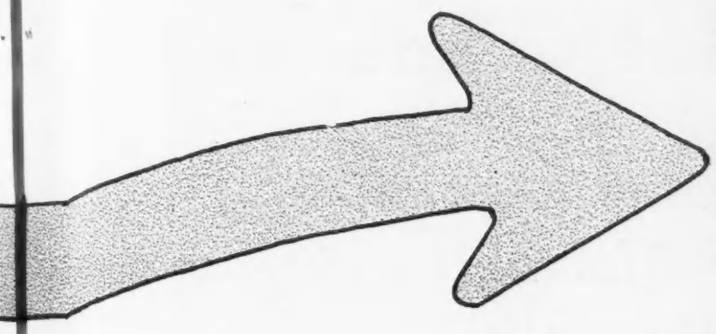

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When they figure it up they will probably be astounded to find that on the average they use their cars to the tune of about **15 miles** per day.

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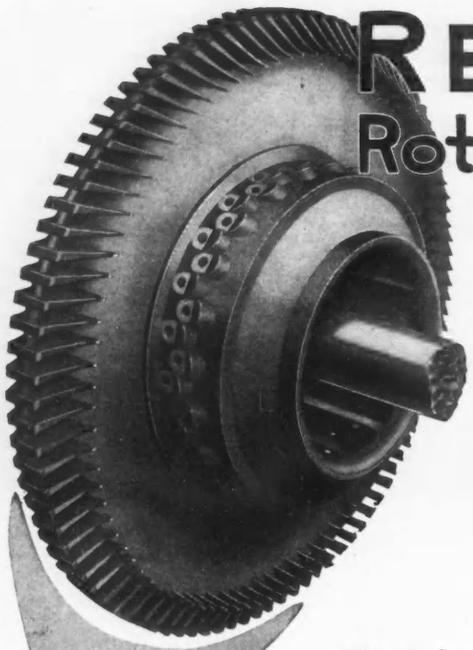
For the average man, 99% of whose driving is done in the city and suburbs, there is no automobile investment of equal value with the Detroit Electric.

Company, Detroit, Mich.



REES "RoTURBo"
Rotary Jet Condenser

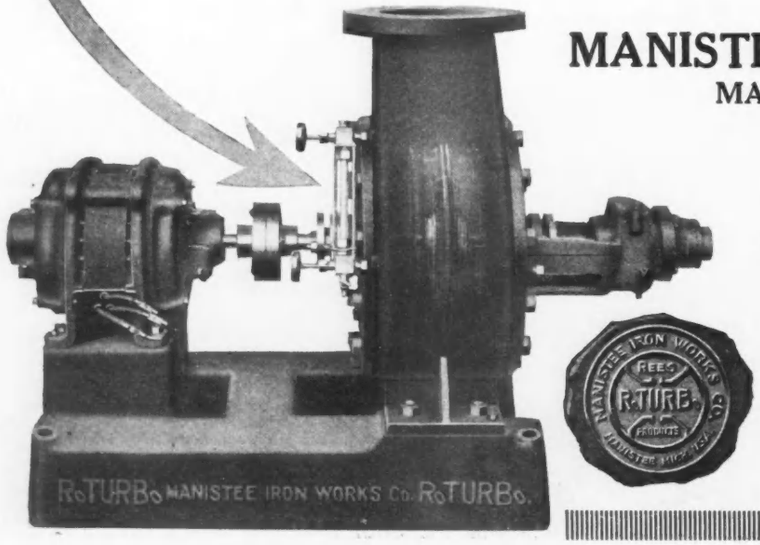
Automatic Regulation Under Fluctuating Steam Conditions Without Speed Regulation

That feature makes history of one of the hardest condenser problems of the past. No more "choking"—no more flooding of the engine or turbine.

There's a perfect balance between the centrifugal force of the ejector fan and the vacuum in the mixing chamber. They vary directly. They can't get out of balance. If the vacuum falls below normal the condensate is ejected at maximum speed; if the vacuum rises and tends to cause "choking," the fan blades fill up with water and exert a greater centrifugal force. The operation is just as perfect as the theory—**without any speed regulation.**

This is just one of the REES "RoTURBo" advantages made possible by unit design—all functions performed by a single rotating part.

Reduction of wearing parts and possibility of disorder, and greater economy of space are two others. And that's not all. But for the complete information you must read our Bulletin 50. Send for your copy today.



MANISTEE IRON WORKS CO.
MANISTEE, MICHIGAN

New York, 50 Church St.
Philadelphia, 848 Drexel Bldg.
Pittsburgh, Park Bldg.
Cincinnati, Ohio, Union Trust Bldg.
Cleveland, Ohio, 876 Rockefeller Bldg.
Detroit, 426 Dime Bldg.
Chicago, Old Colony Bldg.
St. Louis, 1984 Railway Exchange Bldg.
Milwaukee, Wells Bldg.
St. Paul; 2542 University Ave., (J. G. Robertson).
Atlanta, Ga., 515 Third National Bank Bldg.
New Orleans, 917 Hennen Bldg.
Jacksonville, Box 495.
Richmond, Va., 418 American Nat'l Bank Bldg.
Birmingham (McClary-Jemison Machinery Co.)
Dallas, Tex., Southwestern Life Bldg. (Smith & Whitney).
Denver, Colo., opp. Union Depot (Hendrie & Bolthoff Mfg. & Supply Co.)
San Francisco, 112 Market St.
Seattle, Wash., 803 Northern Bank Bldg.

The HUBBELL STANDARD LINE OF INTERCHANGEABLE PLUGS AND RECEPTACLES

A WORLD OF HUBBELL SERVICE

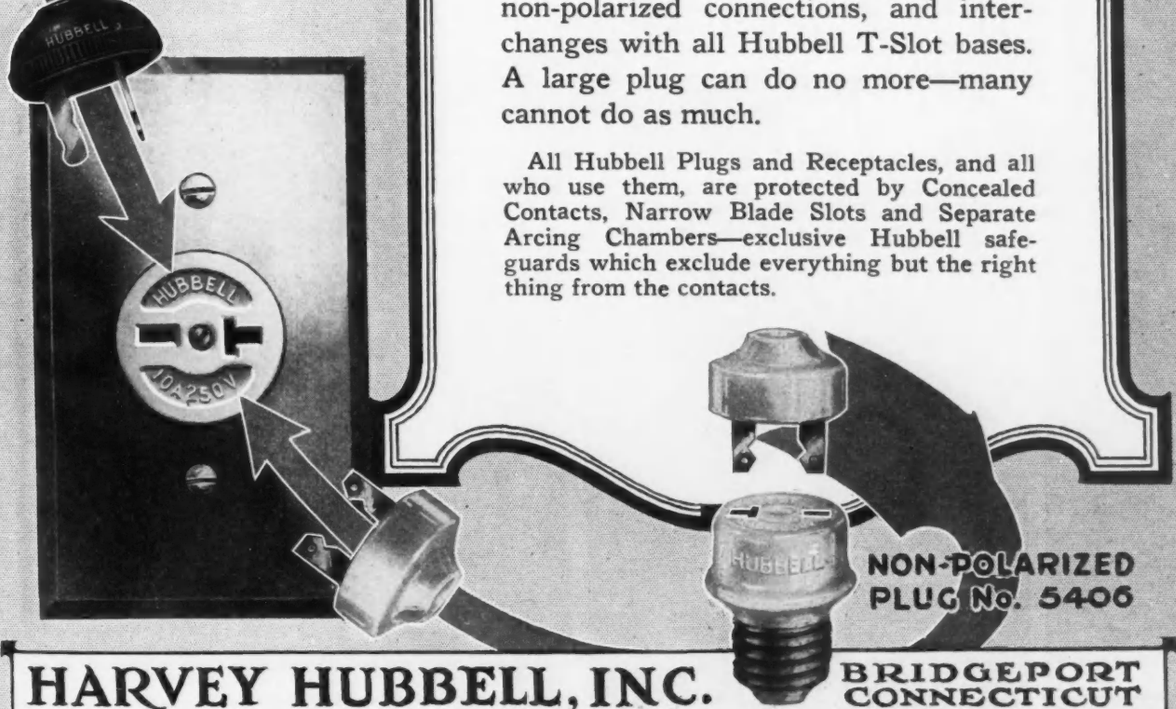
Polarized Plug No. 6915

A Dwarf in Size—A Giant in Service

HUBBELL Polarized Plug No. 6915 is the one to use where a neat, compact plug is desired—and that's most everywhere. It will not mar the appearance of the finest fixture.

Plug 6915 has no limitation but its size. It can be used equally well on devices requiring either polarized or non-polarized connections, and interchanges with all Hubbell T-Slot bases. A large plug can do no more—many cannot do as much.

All Hubbell Plugs and Receptacles, and all who use them, are protected by Concealed Contacts, Narrow Blade Slots and Separate Arcing Chambers—exclusive Hubbell safeguards which exclude everything but the right thing from the contacts.



HARVEY HUBBELL, INC. BRIDGEPORT CONNECTICUT

They cut the coal rate 1/3rd

When the Holyoke (Mass.) Street Railway Company's power plant was reconstructed to take care of increased load various improvements cut the coal rate from 3.5 lb. per kw. hr. to 2.3 lb. per kw. hr.—34% economy.

One of the "various improvements" was

The Taylor Stoker

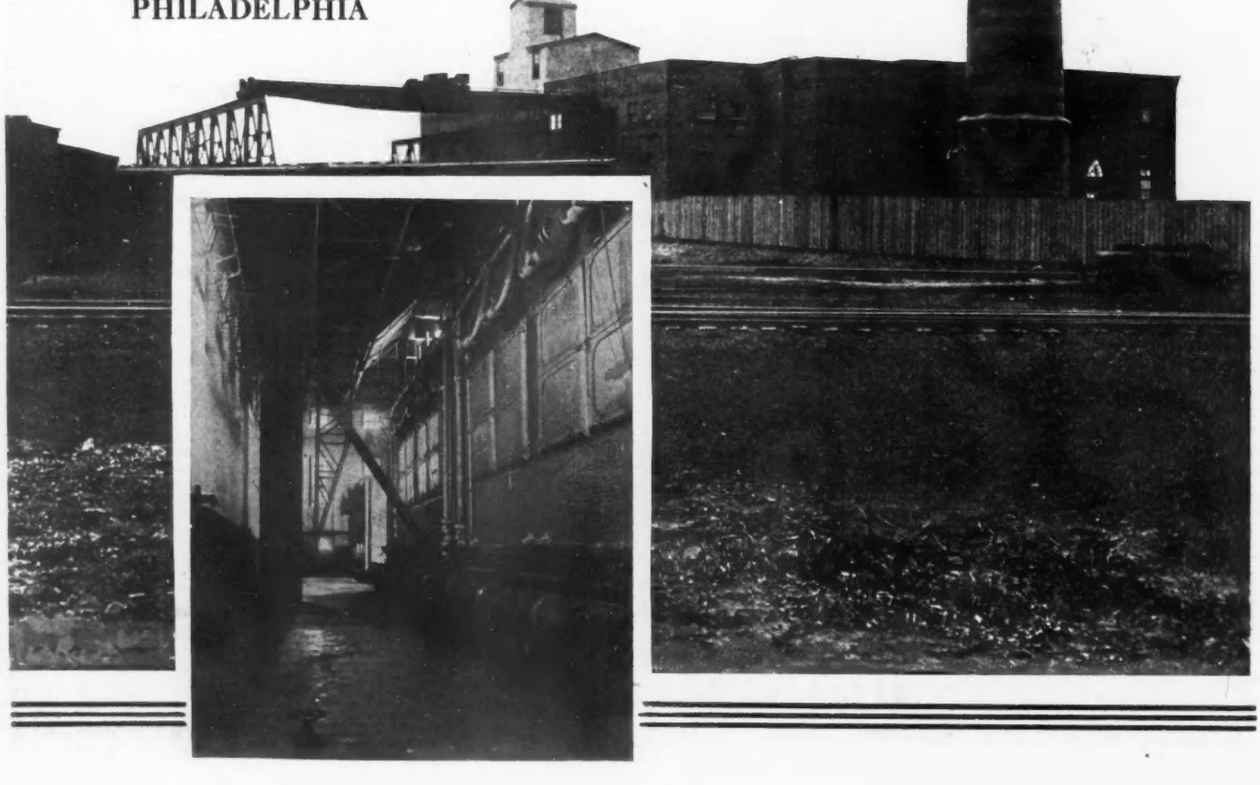
—*four of 'em*—6-retort TAYLOR stokers on 500 HP. B. & W. Boilers.

TAYLOR Stokers have improved the efficiency of *scores* of central station and street railway power plants the country over—large and small.

Witness the experience of the Interborough Rapid Transit Company with 96 TAYLOR Stokers—the Detroit Edison Company with 72 TAYLOR Stokers—the New York Edison Company with 171 TAYLOR Stokers—and so on through the long list. Write for the PROOF in our booklets. "Fuel Burning Reports"—copies free on request.

THE AMERICAN ENGINEERING CO.

PHILADELPHIA



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consists largely in knowing where to find useful facts and how to apply them.

The useful facts which you find week by week in Electrical World will always be available for use if you have your copies bound.

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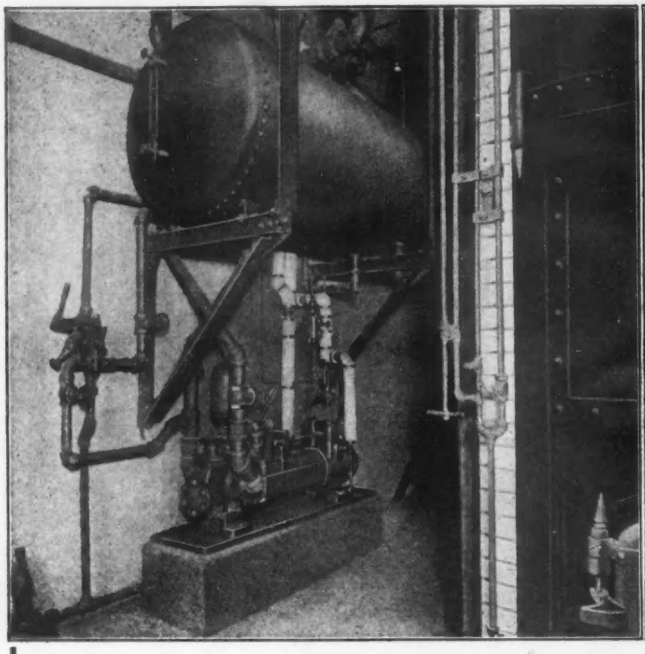

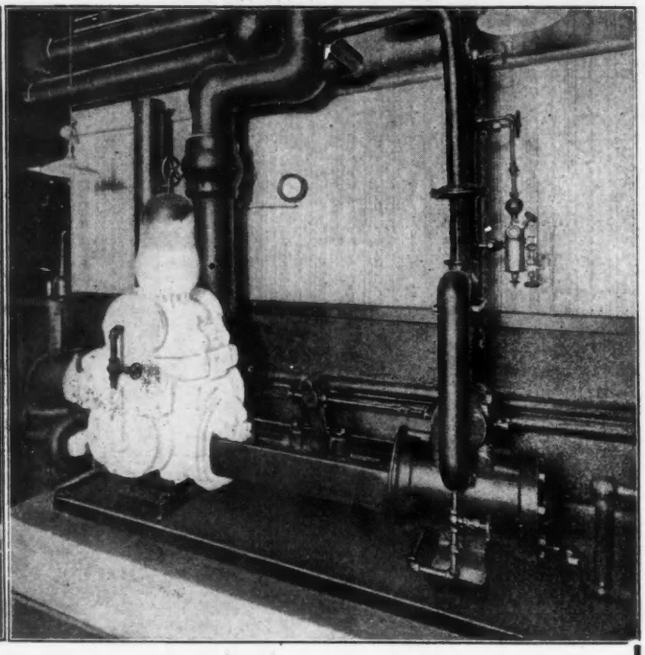

View in Boiler Room Castle Square Hotel, Boston, Mass.

BLAKE-KNOWLES

Style "A" Simplex Pumps

in the power plant of the Castle Square Hotel, Boston. One feeds two 200 H.P. boilers—the other feeds a Linde Ice Machine

In the fire room of the Castle Square Hotel, Boston, is a Blake-Knowles Horizontal Simplex Style "A" Boiler Feed Pump of the piston type, size 7½x4½x10 It runs continuously, night and day, and feeds two 200-H.P. Babcock & Wilcox boilers carrying a steam pressure of 100 lb. The picture shows pump arrangement overhead tank from which the returns from heating coils, drains, etc., are pumped back to the boilers.

The pump will do its work with a total steam consumption of only 242 lb. steam per hour, which for a pump of this small size is a showing that we don't mind talking about. This pump is now working at about two-thirds normal rated capacity; at full capacity it will make even a better record.

The right hand picture shows a Blake-Knowles Simplex Style "A" Brine Pump, size 10x12x12, which the Castle Square Hotel uses for circulating brine in connection with a Linde Ice Machine. The pump is one of the latest Blake-Knowles Simplex Style "A" models and operates against a head of about 40 lb. per square inch. This pump has been in active service for about two years, running continuously and with practically no attention, without repair and shows no sign of wear. It has given noteworthy service in the matter of economy and has been eminently satisfactory from the start.

The reason for the economical showing, in all Simplex Style "A" Pumps, and greater figures than the above for larger capacity pumps of the line, lies—in simple but intelligent design—few wearing parts, stuffing boxes, and packings required—careful construction—reduced amount of steam cylinder condensation—and last, the fact that short stroking *cannot* occur under any conditions of running.

It will be worth your while to investigate the Blake-Knowles Style "A" line of pumps. Let us help you do it.

Bulletin BK-876-38 will be sent on receipt of your name and address.

WORTHINGTON PUMP AND MACHINERY CORPORATION

115 Broadway, New York **Blake & Knowles Works, East Cambridge, Mass.**

BRANCH OFFICES:

Atlanta Boston Buffalo Chicago Cincinnati Cleveland Denver Detroit El Paso Houston Kansas City
Los Angeles Louisville New Orleans Philadelphia Pittsburgh St. Paul St. Louis Salt Lake City San Francisco Seattle

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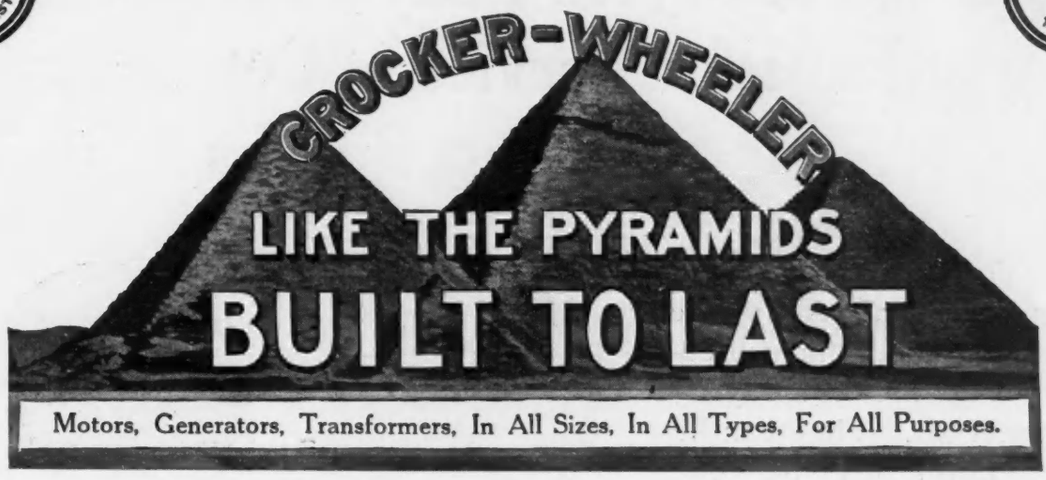
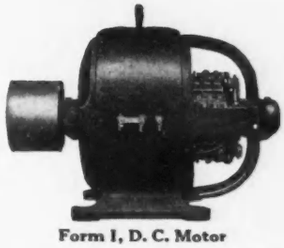


Motors, Generators, Transformers, In All Sizes, In All Types, For All Purposes.

EFFICIENCY and ECONOMY

The most efficient motor is the one that delivers the greatest power with the least consumption of electric current.

The most economical motor is the one that gives the greatest service at the least cost.



Form I, D. C. Motor

An efficient motor may not be economical. It may save a penny or two in the cost of current, but this apparent saving may be more than offset by the cost of repairs and replacements, to say nothing of interrupted production, idle investment, etc.

DEMAND ECONOMY when buying motors. Economy means efficiency and service. Make the first cost of your motors the last cost. Insist on CROCKER-WHEELER "Built to Last" motors. They are ECONOMICAL—EFFICIENT, RELIABLE, DURABLE.

CROCKER-WHEELER

COMPANY
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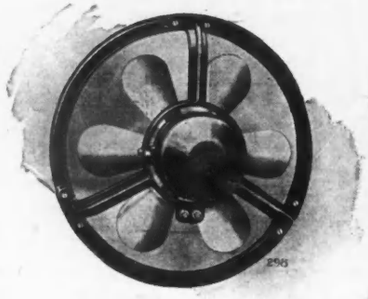
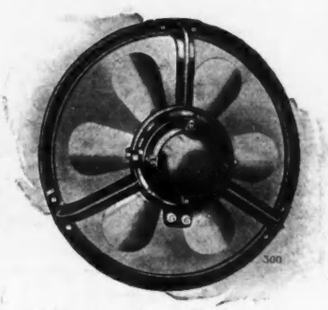
NEW YORK
PHILADELPHIA
PITTSBURG
ST. PAUL
SAN FRANCISCO
SYRACUSE

Robbins & Myers Fully Enclosed Exhaust Fans for Service in Compressed Air Spraying Booths

These Fans are fully enclosed, affording the motor complete protection against the spraying materials. They can be used for drawing the vapor from compressed air spraying booths where japan, enamel, varnish, bronze and other materials are applied.



Direct Current



Alternating Current

The fans are also suitable for service where the air contains grease, dust, acids and other materials which need to be drawn out of interiors.

Two sizes are furnished, 12 and 16 inches in diameter. Both sizes have six blades and are supplied complete with a tripod ring, ready for mounting in the booth or wall.

They can be supplied for operation on all ordinary direct and alternating current circuits.

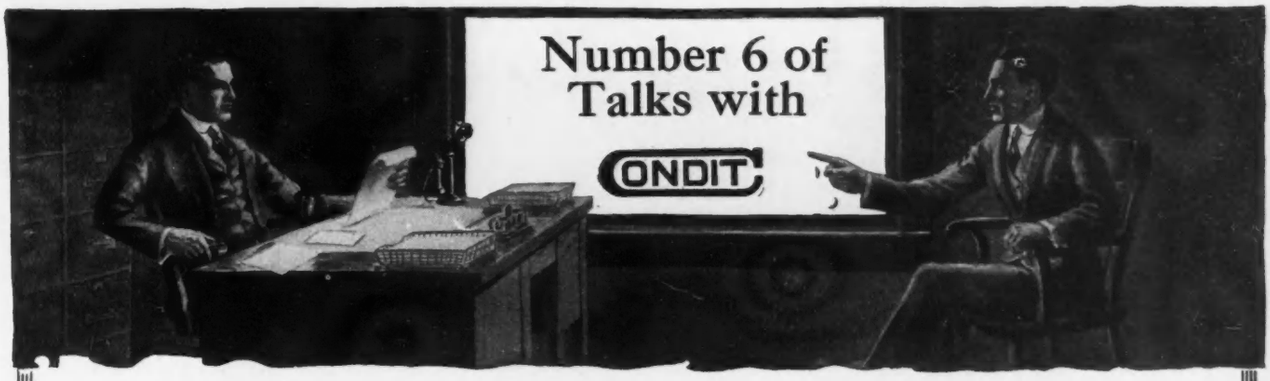
Descriptive folder and prices on request

The Robbins & Myers Company

Springfield, Ohio

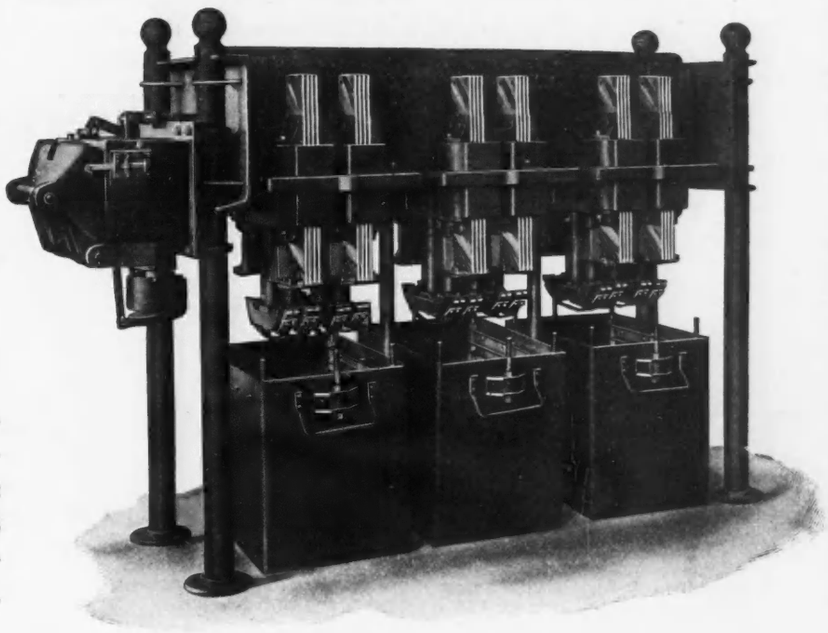
New York Philadelphia Boston Rochester Cleveland Cincinnati Chicago
St. Louis San Francisco

Robbins & Myers Motors



"As you probably know, we are greatly enlarging our plant. In connection with our preliminary investigation, I had occasion to visit several large industrial plants and noticed a number of

Type Y Elctrically Operated Oil Circuit Breakers



in service. In response to my inquiries I was told that the operation of this breaker was satisfactory in every respect.

"We intend to install an oil circuit breaker of approximately 5000 amperes capacity, and are very favorably disposed toward your Type Y. Now, then, delivery is a mighty important item. How soon can you ship a breaker of this description? Is it a question of several months?"

"No, sir, shipment of this type of breaker can be made in a few weeks. Increased manufacturing facilities make this possible."

Condit Electrical Mfg. Co.

Manufacturers of Electrical Protective Devices

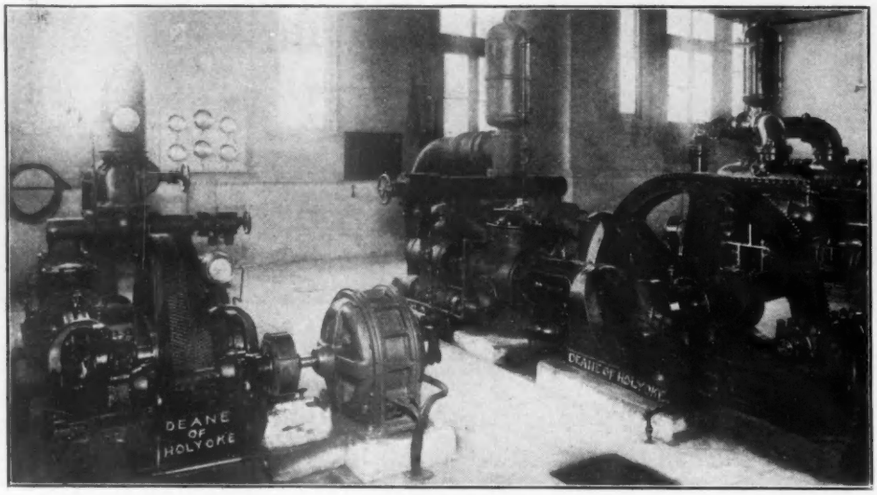
Akron, Walsh Bldg.
Buffalo, 1205 Electric Bldg.
Charlotte, N. C., Commercial Bank Bldg.
Chicago, 19 South Fifth Ave.
Cincinnati, Union Trust Bldg.
Dallas, 408 South Ervay St.

Boston, Mass.

Denver, 1621 Seventeenth St.
Detroit, 616 Ford Bldg.
Kansas City, Mo., Traders Bldg.
Los Angeles, San Fernando Bldg.
Minneapolis, Film Exchange Bldg.
New York, 39 Cortlandt St.
Philadelphia, 929 Chestnut St.
Pittsburgh, 947 Penn Ave.
St. Louis, La Salle Bldg.
Salt Lake City, 257 South Main St.
San Francisco, 583 Howard St.
Seattle, 309 First Ave., South.
Troy, 332 River St.
Washington, D. C., Conduit Road & Elliott St., N. W.

Northern Electric Company LIMITED

Sole Distributor for the Dominion of Canada, Montreal, Halifax, Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver, Victoria.



Printed by permission of the Worthington Pump & Machinery Corporation

We Don't Need to Introduce Deane of Holyoke, Mass.

So we are just calling your attention to the fine herring-bone gears and pinions of these two pumps. They are coated with

TEXACO CRATER COMPOUND

The Great Gear Lubricant

The manufacturer says, "The application of TEXACO CRATER COMPOUND to pump gears, as shown in this illustration, will reduce wear and noise to practically negligible quantities."

It is the same thing on all gears. TEXACO CRATER COMPOUND reduces noise because it reduces wear.

It reduces wear because CRATER sticks to the wearing surface of the gear teeth—can't be squeezed out or flung off.

Prevents metallic contact; the teeth run on a film of pure lubricant.

CRATER saves the gears.

That's why so many manufacturers are glad to recommend the use of TEXACO CRATER COMPOUND on their gears and that's why you should be using it.

If you want to learn more about CRATER, ask us to send you the CRATER BOOK, 32 pages, with pictures showing this great lubricant in use under various conditions.

Or better yet, take advantage of our "make-good" offer: We will send you, express prepaid, a 25-pound can of CRATER COMPOUND for $3.00. The price is very much less in larger quantities. You don't have to pay for this unless it does just what we say.

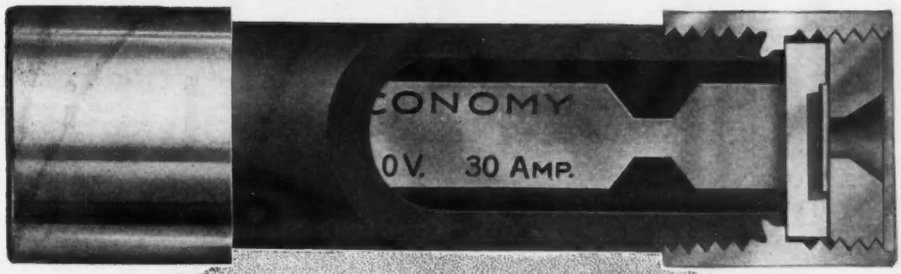
Whether you want the trial can or just the CRATER BOOK, address Department L 2, 17 Battery Place, New York City.

THE TEXAS COMPANY

Lubricants for All Purposes

CHICAGO HOUSTON NEW YORK

Offices in Principal Cities



Are you still using "one-time" fuses? Why spend five times more than necessary to secure electrical protection? Save 80% of your present yearly fuse costs by using

ECONOMY renewable cartridge FUSES

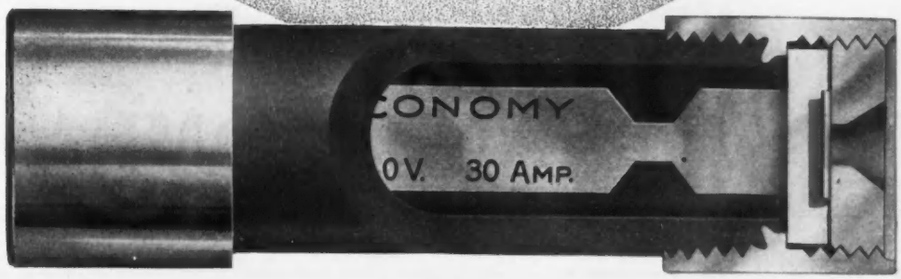
If you sell fuses, are you deriving the benefit of the big Economy National Advertising Campaign? Watch the ads in the Saturday Evening Post. Glad to have you tell us what you think of these dealers' sales helps.

Stock up now. The demand will increase with the force of the publicity drive.

Samples Free—Catalog No. 19 Free.

Economy Fuse & Mfg. Co.
Kinzie and Orleans Sts.
CHICAGO

Economy Fuses have been carefully investigated by U. S. Gov't Bureau of Standards

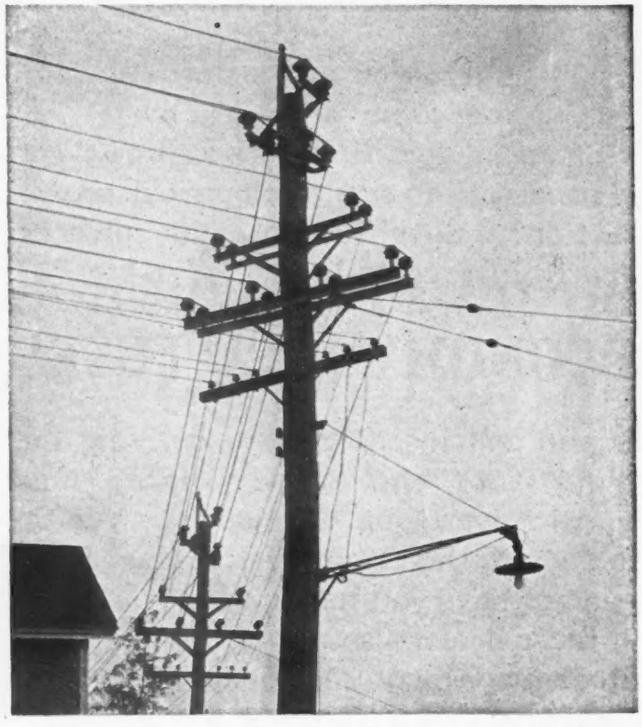


Peirce Forged Steel Pins

For Your High Voltage Lines

For any Insulator—For any Crossarm—For any Mechanical Load

For Bo Arrow and Angle Steel Crossarms



No. 5127 Forged Steel Pins on 22,000 and 11,000 Volt Lines of The Duquesne Light Co.

For Wood Crossarms

Punctured insulators or broken pins cause most high tension line failures.

Most insulator punctures are really caused by the expansion and contraction of heavy cast iron thimbles cemented in the insulators for use on the old types of cast iron pins. The Peirce Pin has a thin, light, sheet steel thimble, which entirely eliminates this source of trouble.

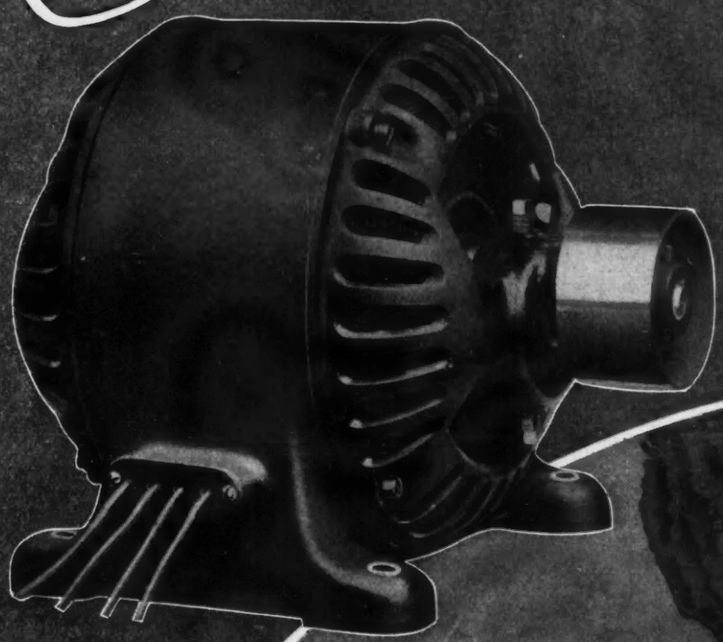
You can stop your broken pin trouble, too, if you use Peirce Forged Steel Pins, for each Peirce Pin is made of a single bar of open hearth steel, forged and hammered to shape, without a single welded joint, and is absolutely dependable.

Look up pages 50 to 62 of your 1916 Hubbard Catalogue, and see which catalogue number of pin you need.

The Hardware MAKES the Line
Hubbard Makes THE Hardware

HUBBARD AND COMPANY
PITTSBURGH

Peerless Motors



A scurry for materials and a hurry for motors

The situation in the motor business is curious just now. Never was the demand for motors more pressing—never were motor materials harder to come by.

Wire, brass, iron, steel, insulation, and skilled labor—all essential in motor making—become scarcer and more costly, almost daily.

In the face of these difficulties Peerless Motor Service is doing everything humanly possible for our customers' protection in motor quality, in equity of price, and in the best possible deliveries.

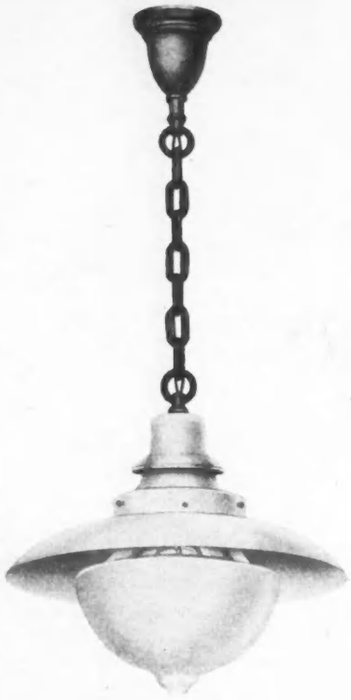
THE PEERLESS ELECTRIC CO.
WARREN, O.

New York—C. O. HALL, 147 W. 35th St.

Chicago—Electrical Machinery Sales Co., 327 S. La Salle St.

Philadelphia—M. H. RODDA, 618 Witherspoon Bldg.

DENZAR



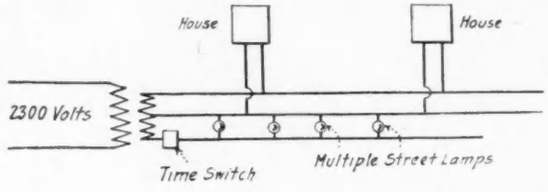
The Unit of Day Brightness

The DENZAR enables you to use to the best advantage every ray of light from the type "C" lamp.
It is constructed so as to remove all irritating glare.
Gives you the greatest amount of light in exactly the right intensity on the working plane.
No solid reflectors or supporting rods to cast unsightly shadows.
Being an enclosed unit there are no large available openings for dirt, insects and foreign matter to enter, causing ugly spots on the bowl.
All surfaces are highly polished so as to be dust-resisting, making the Denzar as easy to clean as a bare lamp.
The Denzar Bowl is made of one piece of glass, the upper half of which is of clear glass.
This bowl in combination with the opal reflector allows no absorption or waste of light.
Dealers and Central Stations. Let us tell you more about the Denzar. The selling possibilities in your territory are great.

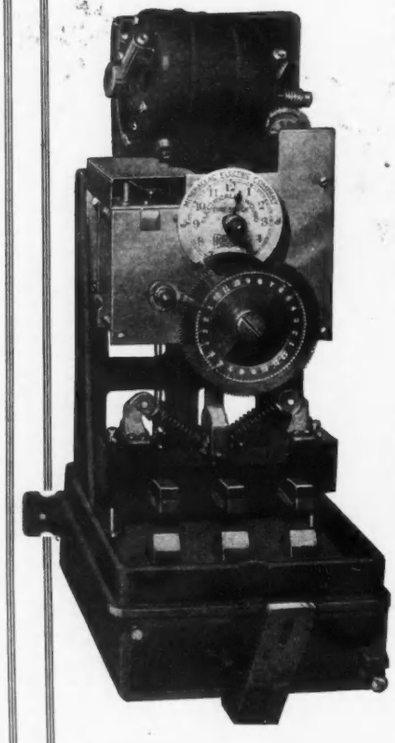
Beardslee Chandelier Mfg. Co.
221 South Jefferson Street
Chicago, Ill.

VILLAGE STREET LIGHTING MADE PROFITABLE
by use of the
MINERALLAC
MOTOR WOUND **TIME SWITCH**

The following diagram shows how the Minerallac Motor-Wound Time Switch is used by the Cumberland Co. Pwr. & Lt. Co. of Portland, Me., to make village street lighting in scattered rural districts profitable.



120 volt, multiple incandescent lamps are connected between one side of the line and the neutral from a three-wire commercial lighting transformer. The Minerallac Time Switch is installed on the pole and connected between the transformer secondary and the lamps.



It is motor wound and unaffected by weather conditions, therefore requires no winding and no attention.

The saving thus made is so large that a class of business formerly regarded as financially impracticable is now attractive.

Send for further information.

MINERALLAC ELECTRIC COMPANY
1043 W. Washington Blvd. CHICAGO

A FUTURIST PICTURE

In your future work of decreasing the speed of small motors, or using low voltage motors on higher supply voltages, or using universal motors on A.C and D.C. receptacles of supply voltage this Ward Leonard Adaptor Resistance can be supplied in any capacity or resistance desired.

It is a resistance unit with an Edison base screw plug at one end and an Edison socket at the other.

Write for circular.

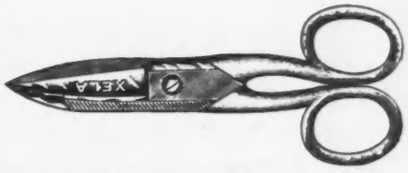
Ward Leonard Electric Co., Mt. Vernon, N. Y.

BADT WESTBURG ELECTRIC CO., Chicago, Ill. JOHN B. SEBRING, Pittsburgh, Pa.

Genuine Leather Tool Bag

Canvas Tool Bag

TOOLS



of Every Description
for Your New Year's Requirements.

Let your specifications for 1917 read:

"KLEINS"

and thereby assure increased tool efficiency and decreased tool maintenance.

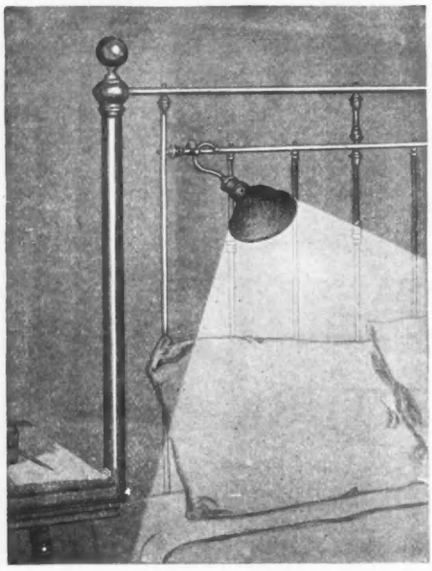
OUR NEW CATALOG NO. 17 IS READY FOR DISTRIBUTION.

Seen it yet? Mailed on request.

Mathias Klein & Sons, Mfrs.

Canal Station 32,
Chicago

FARIES FIXTURES



Faries Patent Adjustable Bed Brackets sell because they are convenient

The logical place for a bed-room light is at the head of the bed. It is convenient when you go to bed, convenient when you get up, to read by, to see the clock, to see if the rain is coming in the window. It is invaluable for the sick room. The shade may be inverted for soft, indirect lighting. It is made for wood or metal beds.

To sell them simply show them

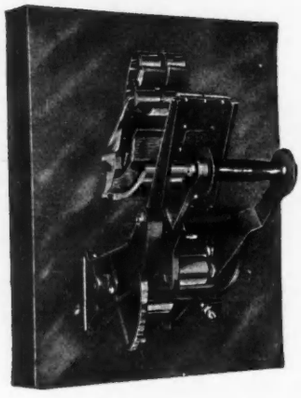
A complete line of attractive portable and adjustable fixtures shown in our new catalog No. 24.

Catalog No. 24

FARIES MFG. CO.

DECATUR, ILL.

As a rule, the reliability of any piece of apparatus is directly proportional to its simplicity



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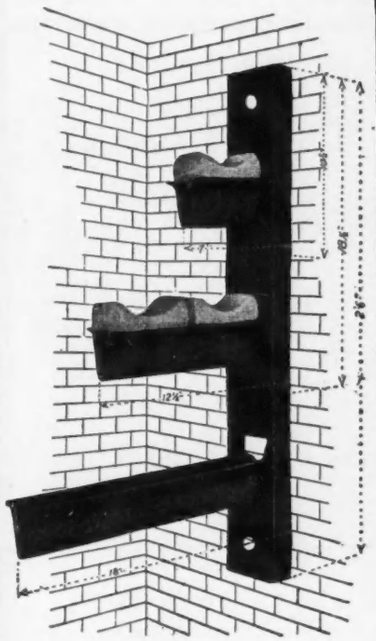

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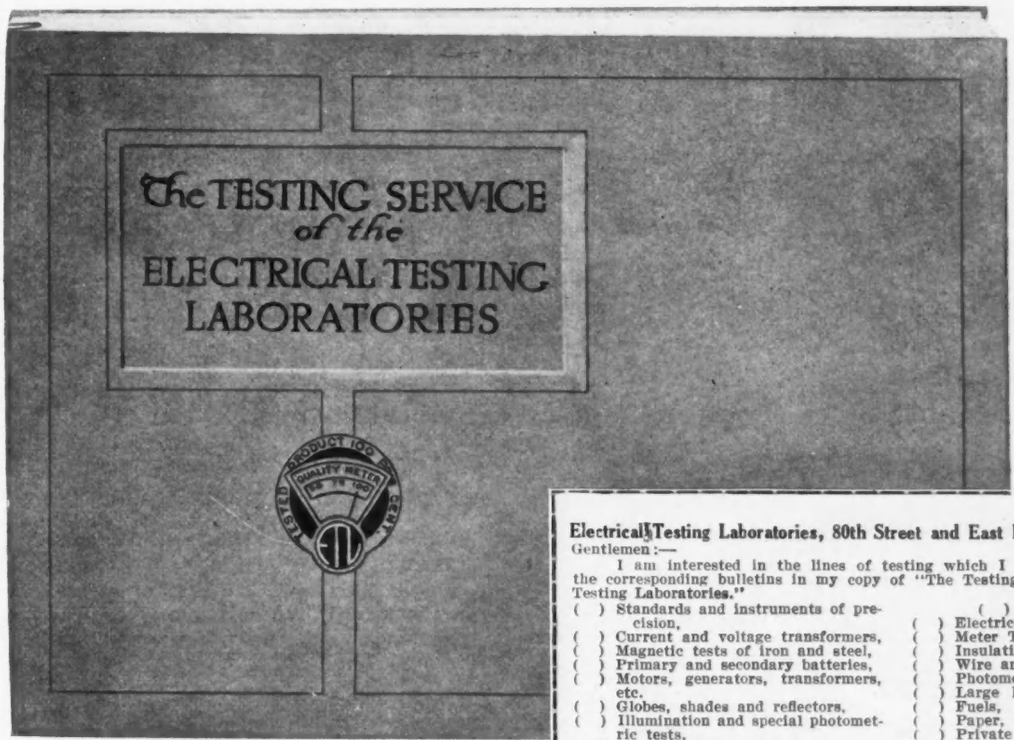

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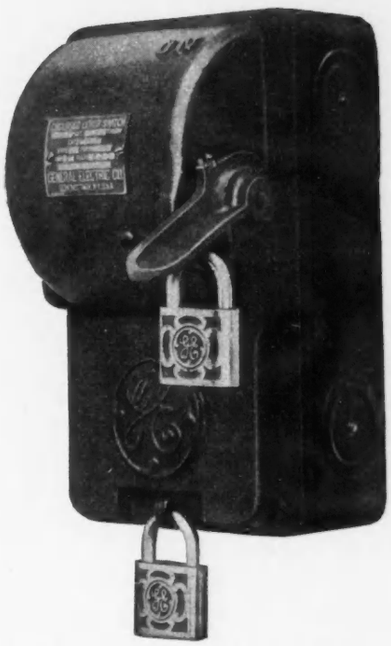
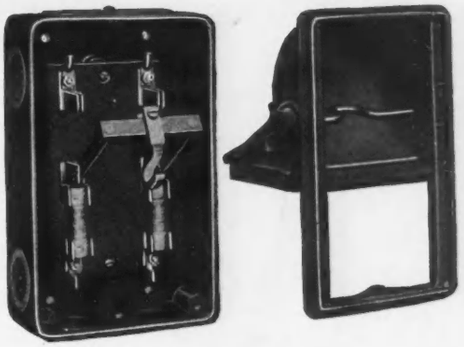


Fuse chamber locked "closed"
Switch locked "off"

Switch "off"
Fuse chamber
"open"



Cover removed
to show interior
of switch

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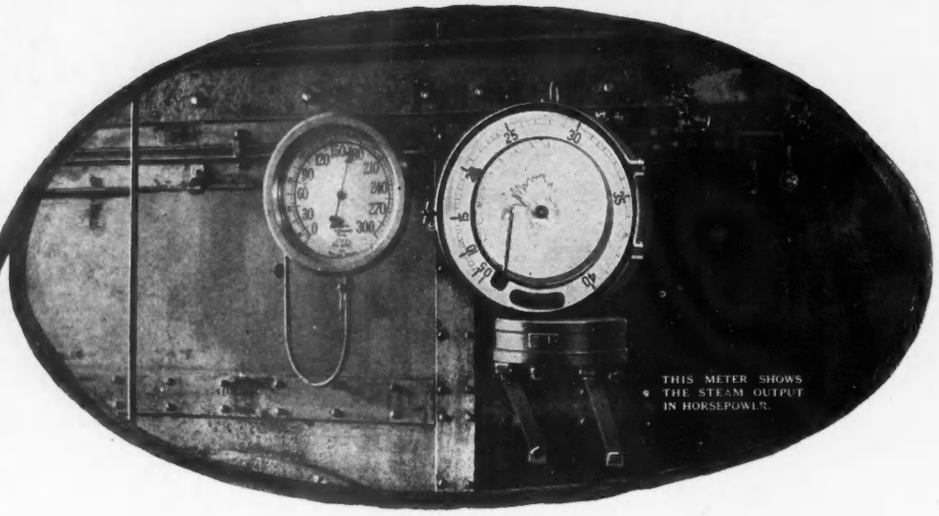

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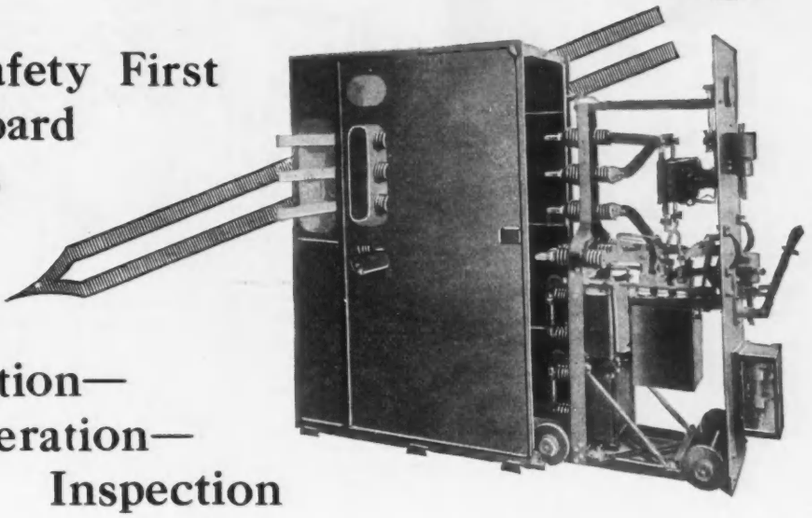

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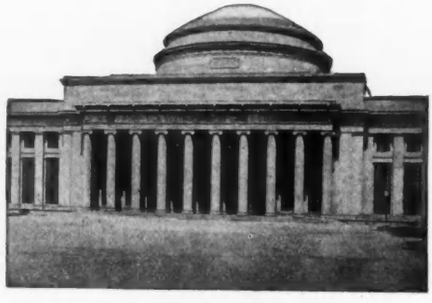

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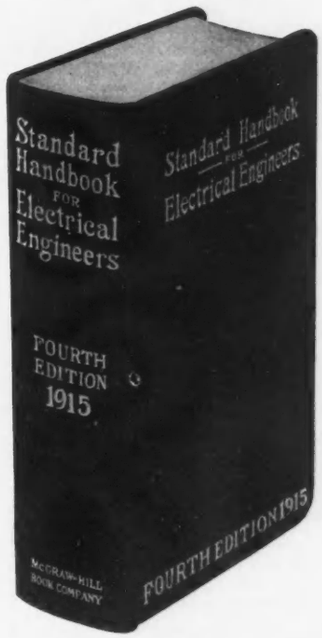

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1	75	Western Elec., 3-phase, rev. field, 2300 volts, direct-connected to Ideal engine.	257
1	75	West'house, 2-phase, rev. field, 2300 volts, direct-connected to Skinner engine.	277
1	75	West'house, 3-phase, rev. field, 2300 volts, direct-connected to Skinner engine	
1	75	Crocker-Wheeler, 2-phase, rev. field, 2300 volts, direct-connected to "Erico" engine.	277
1	75	Crocker-Wheeler, 3-phase, rev. field, 2300 volts, direct connected to "Erico" eng.ne,	277
1	100	Westinghouse revolv. field, 2300 v., 3-phase, to McEwen engine.	257
1	110	West'house, 3-phase, rev. field, 250 v.	600
1	120	West'house, 3-phase, rev. armature, comp., 2200 volts	720
2	180	West'house, 3-phase, 220-440 v. revolv. armt.	514

3 Phase, 40 Cycle, 550 Volt

	H.P.		Speed
1	5	Westinghouse, CCL.	1120
1	5	Westinghouse, CCL.	570
2	10	Westinghouse, CCL.	1120
4	15	Westinghouse, CCL.	1120
1	15	Westinghouse, F.	850
5	20	Westinghouse, CCL.	1120
1	30	Westinghouse, CCL.	1120
4	30	Westinghouse, CCL.	760
1	40	Westinghouse, CCL.	760
1	75	Westinghouse, CCL.	1120

3 Phase, 60 Cycle

	HP.		Speed
	We have an enormous stock of *new* motors, sizes 1 HP. to 10 HP., actually on hand. Send your inquiries.		
1	12	Gen. Elec., form K, 110 v.	720
1	12	Gen. Elec., form K, 550 v.	720
1	15	Swing, type N10, 220 v.	1200
1	15	Richmond, 220 v.	1140
1	20	Richmond, 220 v.	1140
1	20	Allis-Chalmers, new, 220 or 440 v.	1130
1	25	Gen. Elec., form K, 220 v.	900
1	35	Allis-Chalmers, new, 220 or 440 v.	850
1	40	Westingnouse, type CX, 220 or 440 v.	850
2	50	Gen. Elec., form K, 220 or 440 v.	850
1	75	Westinghouse CCL, 2200 v.	1150
7	75	Allis-Chalmers vertical, 440 v.	480
1	85	Allis-Chalmers, 2200 v., new	580
1	125	Westingnouse CCL, 2200 v.	1140
1	400	Gen. Elec., form L, 2200 v.	514
1	800	Gen. Elec. synchronus, 2200 v.	

220 V. D. C. Motors

	HP.		Speed
2	10	National, MP.	1450
1	10	Peerless, MP, comp.	1125
1	10	Milwaukee, MP.	1000
1	10	Commercial, MP.	950
1	10	Roth, MP.	800
1	12½	Fairbanks-Morse, MP.	1400
1	15	National, MP, type CS, comp.	1200
1	15	Robbins & Myers, MP.	1080
1	20	Fairbanks-Morse, MP.	1100
1	20	Thompson-Ryan, interpole	1000
1	20	Jenney, MP, type D, comp., new.	800
1	20	Western Elec., MP, type G	675
1	30	Sturtevant, MP.	800
1	40	Western Elec., MP, type E60R.	800
1	60	Eager Elec. Co., MP, comp.	750

IN STOCK

Slip Ring Motors

No.	Hp.		Volts
1	15	West'house, 1150 rpm., 3 ph., 60 cy.,	220-440
2	15	West'house, 1150 rpm., 2 ph., 60 cy.,	220-440
1	7½	C.W., 1150 rpm., 2 ph., 60 cy.,	220-440

Squirrel Cage Motors

1	30	West'house, 1150 rpm., 2 ph., 60 cy.,	440-220
1	15	Gen. Elec., 1150 rpm., 2 ph., 60 cy.,	440-220
2	15	Wagner, 850 rpm., 2 ph., 60 cy.,	440-220

Also several smaller A.C. Large stock D.C. We buy, exchange and sell

D. S. HOLCOMB & COMPANY, Inc.
241-243 Canal Street, New York City

SPECIALS

400-kw. G.E. 250-volt generator, direct connected 28 x 48 Corliss engine, with switchboard; seen running; $4,000.

150-hp. G.E. 3-phase, 60-cycle, 440-220-volt, a.c. motor; $1,350.

200-kva. electrical machinery, 3-phase, 60-cycle, 440-220-volt, alternating, 360 r.p.m.; $1,000.

262-h.p. (2) B. & W. watertube boilers, insurance certificate 150 lb.; $1,000 each.

90-kva. Westinghouse 3-phase, 60-cycle, 2300-volt, direct connected Harrisburg engine; $1,400.

60-kw. Sprague 250-volt generator, dir. con. Skinner engine; $1,000.

Two 100-kw. W. E. 250-volt, d.c., direct-connected Ridgeway engines; $1,400 each.

Power Machinery Exchange, Inc.
1 Montgomery St. Jersey City, N. J.

Wanted Daily 100,000 Lbs.

CLEAN COPPER SCRAP
NEW BRASS CLIPPINGS
SHRAPNEL CASE SCRAP

CONSOLIDATED
ROLLING MILLS & FOUNDRIES CO., INC.
25 BROAD ST., NEW YORK CITY

FOR SALE

Two 615 B.H.P. four-cylinder vertical Willans Diesel Oil Engines, direct coupled to two 530 K. V. A. three-phase, 60 cycle, 2300 volt, 180 r.p.m. Generators. These machines are new and in their original packing cases. Full particulars on application to

G. E. WINTER
210 Bank of Ottawa Bldg.,
Vancouver, B. C., Canada

SEARCHLIGHT SECTION

6—135 H.P. ALLIS-CHALMERS SLIP RING TYPE MOTORS, 3 PHASE, 60 CYCLE, 550 VOLT, 400 RPM. WITH CONTROLLERS AND RESISTANCE. INSTANT SHIPMENT.

1—300 H.P. GENERAL ELECTRIC FORM K., 3 PHASE, 60 CYCLE, 2300 VOLT, 514 RPM., COMPLETE WITH COMPENSATOR.

A. C. TURBINES

1—500 K.W. General Electric Curtis Vertical Steam Turbine, 3 ph., 60 cy., 2300 v., 1800 RPM.
1—125 K.V.A. 100 K.W. Westinghouse turbo unit horizontal type Generator wound for 3 ph., 60 cy., 240 v., 3600 RPM. Complete with exciter, switchboard and instruments.
1—100 K.W. General Electric horizontal type turbo unit. Generator wound for 2 ph., 60 cy., 2200 v., 3600 RPM., designed for 150 lbs. steam pressure non-condensing.

DIRECT CONNECTED ALTERNATING CURRENT UNITS

1—800 K.W. Hullock 2 ph., 60 cy., Rev. field type alternator direct connected to 24 and 48 x 48" cross compound Fulton Iron Wks. engine; speed 90 RPM.
1—250 K.V.A. General Electric, 2 or 3 ph., 60 cy., 240 v., 150 RPM., direct connected to 14 and 28 x 30" Allis-Chalmers horizontal cross compound engine.
2—250 K.W. General Electric 3 ph., 60 cy., 2300/4000 v., 36 amp., 150 RPM. Rev. field type alternators direct connected to 15¼ and 28½ x 30" Buckeye cross compound engines. Units complete with 30 K.W., 125 v. exciters.
1—150 K.W. Westinghouse 3 ph., 60 cy., 2300 v., direct connected to Ball & Wood 12 and 24 x 24" tandem compound engine, speed 150 RPM.

BELTED ALTERNATING CURRENT DYNAMOS

1—350 K.V.A. G. E. type ATB., 3 ph., 60 cy., 6600 v., 450 RPM. (Can be reconnected for either 240 or 480 v.)
1—300 KW. Westinghouse, 3 ph., 60 cy., 2300 v., 3 bearing design, 300 RPM. (Can be reconnected for 600 v.)
1—200 K.W. Westinghouse 3 ph., 60 cy., 2200 v., 600 RPM. Rev. field type, complete with belted exciter.
1—100 K.W. Allis-Chalmers 3 ph., 60 cy., 2300/4000 v., 900 RPM. alternator with direct connected exciter.
1—50 K.W. General Electric type ATB., form P., 3 ph., 60 cy., 600 v., 1200 RPM.

DIRECT CONNECTED DIRECT CURRENT UNITS

1—600 K.W. General Electric, 250 v., 120 RPM., direct connected to 22 and 44 x 36" McI. & S. cross compound, four valve vertical engine.
1—250 K.W. three wire unit consisting of 2—125 K.W. Crocker Wheeler type CCD., 125 v., 8 pole, 250 RPM., direct connected to 15½ and 31 x 16" Ball & Wood center crank tandem compound engine.
1—150 K.W. Westinghouse 250 v., compound wound, 6 pole generator direct connected to Westinghouse cross compound vertical right hand engine, size 14 and 24 x 14".
1—100 K.W. Westinghouse 250 v., 6 pole, 257 RPM., direct connected to 15 x 16" Harrisburg side crank piston valve engine.
1—100 K.W. three wire unit, consisting of 2—50 K.W. Allis-Chalmers 6 pole, 275 RPM., 125 v. generators, direct connected to vertical cross compound Reeves engine, 10 and 18 x 12".
1—75 K.W. Westinghouse, 250 v., 6 pole, 290 RPM., direct connected to 12 and 20 x 12" Westinghouse engine.
1—75 K.W. General Electric 125 v., 6 pole generator, direct connected to 14 x 14" Harrisburg left hand centre crank engine, speed 270 RPM.
1—75 K.W. Thompson-Ryan 125 v., compound wound generator, 10 pole, direct connected to 9 and 16 x 14" McEwen tandem compound non-condensing engine.

TRANSFORMERS

3—375 K.V.A. Westinghouse 60 cy., single ph. transformers. 2300 v. prim., 575 v. secy.
3—185 K.V.A. General Electric type A.B., 25 or 60 cy., 2300-430 v.
3—75 K.W. Westinghouse 25 or 60 cy., 6600-220 v.
10—15 K.W. General Electric type H., form G., 60 cy., 2200/110 v.
10—10 K.W. General Electric 25 cy., type H., form G., 2200 or 6600 v. prim., 110 v. secy.
5—10 K.W. Westinghouse 25 or 60 cy., 2200-440/220 v

ARCHER & BALDWIN

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HAROLD R. WILSON MACHINERY CO.

ELECTRIC & STEAM MACHINERY SECOND HAND
Federal Reserve Bank Bldg., ST. LOUIS, MO.
Direct Connected D.C. Units 125-250 Volts

K.W.	Make	Volts	Poles	Sp.	Make Engine
3—1000	Westge.	250	14	90	32&64x54 R. & S. Cor. H. C. C.
3— 900	C. W.	250	..	160	26&32 double T. C. Gas
600	Gen. El.	250	12	120	22&44x36 MacI. & S. V. C. C. 4-v.
3— 400	Westge.	250	10	156	14&30x30 MacI. & S. T. C.
400	G. E.	250	8	80	28x48 Corliss
400	C. W.	250	..	250	21x24 4 cyl. R. J. Gas
2— 336	G. E. 3-W.	160	..	...	16&27x24 Russell T. C.
200	Burke	250	10	200	18x21 Erie City 4 Valve
200	Westge.	250	..	170	14&25x24 Buckeye C. C.
200	West. El.	250	..	220	14&26x18 Ideal Tand. C.
200	Allis	250	..	200	18x24 double Allis Gas
2— 150	Goodman	250	8	210	18x19 McEwen
150	G. E.	250	..	...	Curtis St. Turbine
3— 150	Allis	250	..	...	16x24 3 cyl. Diesel Oil
150	Gen. El.	250	..	...	Simple Harrisburg Fleming
125	Willey	250	..	200	18x18 Skinner
100	Northern	250	6	260	14x14 Cluse
100	Willey	250	..	250	15x15 Skinner
100	Triumph	250	6	250	Ideal Tandem Comp.

ENGINES—BOILERS—A.C.&D.C. MOTORS, GENERATORS

This is only a partial list. Send for complete one.

FOR SALE

3 PHASE, 60 CYCLE GENERATORS AND MOTORS

1—200 K.W., General Electric Generator, Type ATB, 900 RPM, 2300 Volts with Exciter and a complete three-panel switchboard for controlling.
1—150 K.W., Western Electric Generator, 600 RPM, 6600 Volts, with 8 K.W. Belted Exciter, 120 Volts, 1175 RPM, also used only a few months.
1—90 KVA, Electric Machinery Co. Generator, 900 RPM, 2300 Volts, with 3 K.W. Belted Exciter, 125 Volts, 1550 RPM. slightly used.
1—25 H.P., Willey Motor, 1750 RPM, 220 or 440 Volts, with drum type oil starter.
2—15 H.P. each, Allis-Chalmers, slightly used Motors, at 1150 RPM, 220 Volts and complete with starters.
1—NEW, 7½ H.P., General Electric, Form C, 220 Volt, Induction Motor, at 1800 RPM, with hand starting compensator only.
4—3 Phase, 60 Cycle Transformers, 1100 or 2200 to 110 or 220 volts, sizes 7500 watts, 5000 watts, 2—2500 watts each, and 1—1500 watts.

Also many other generators, motors and electrical machinery as well as engines, boilers and power plant machinery of all kinds in stock.

THE RANDLE MACHINERY CO.,
1822 Powers St. Cincinnati, Ohio

One of our customers has a new

Electra Steam Turbine

designed to deliver 30 h.p. at 700 r.p.m., with 155-lb. steam pressure. Suitable for driving centrifugal pump or fan. Price $395.00.

B. F. STURTEVANT CO.
Hyde Park Boston, Mass.

FOR SALE

250 Kw. Gen. Elec. gen., 3 ph., 60 cy., 6600 volt, 450 r.p.m.
150 Kw. Gen. Elec. gen., 3 ph., 60 cy., 2300 volt, 900 r.p.m.
120 Kw. Gen. Elec. gen., type ATB, 3 ph., 60 cy., 2300 volt, 200 r.p.m., dir. con. to 15 x 18 Buckeye Steam Engine
115 Kw. Allis-Chalmers gen., 3 ph., 60 cy., 2300 v., 900 r.p.m.
250 H.P. Gen. Elec. motor, 3 ph., 60 cy., 440 v., 514 r.p.m.
235 H.P. Gen. Elec. synch. motor, 3 ph., 60 cy., 440 v., 590 r.p.m.
150 H.P. Bullock slip ring motor, 3 ph., 60 cy., 440 v., 600 r.p.m.
150 H.P. Gen. Elec. motor, 3 ph., 60 cy., 440 v., 600 r.p.m.
3—150 H.P. West. motors, 3 ph., 60 cy., 440 v., 580 r.p.m.
120 H.P. Gen. Elec. syn. motor, 3 ph., 60 cy., 440 v., 300 r.p.m.
3—100 H.P. Gen. Elec. motors, 3 ph., 60 cy., 440 v., 600 r.p.m.
100 H.P. Gen. Elec. motor, 3 ph., 60 cy., 440 v., 900 r.p.m.
75 H.P. Gen. Elec. motor, 3 ph., 60 cy., 2200 v., 900 r.p.m.
3—30 H.P. Gen. Elec. motors, 3 ph., 60 cy., 440 v., 900 r.p.m.
7—15 H.P. Gen. Elec. motors, 3 ph., 60 cy., 440 v., 1200 r.p.m.

Our stock also comprises a large list of boilers, engines, water wheels, pumps, mining and milling machinery. Send for complete stock list.

THE MORSE BROS. MACHINERY & SUPPLY CO.
Denver, Colorado

SEARCHLIGHT SECTION

Any Size and Kind For Immediate Delivery

MOTORS-DYNAMOS

We Buy, Sell Rent, Exchange

A PARTIAL LIST OF OUR STOCK—LOOK 'EM OVER—THEY ARE ALL GUARANTEED

Alternating Current 2 and 3 phase

No.	H.P.	Make	Phase	Volts	Speed
1	150	G.E. Vert.	3	220	600
1	100	Wghse.	2	220	1200
1	75	G.E.	2	220	900
1	50	G.E.	2	220	850
1	50	G.E.	2	440	900
1	50	Wghse.	2	220	1200
1	50	Wagner, type K	2	220	1150
1	40	Fbks.-Mse.	3	220	1200
1	40	Wagner	2	220/440	1200
1	40	Wghse.	3	440	900
1	40	Wghse.	3	220	850
1	40	G.E. Slp. Rng.	2	220	900
1	35	G.E.	3	220	1800
2	35	W.E.	2	220	1200
1	35	Wghse.	2	220	1150
1	35	G.E. Slp. Rng.	2	220	900
1	30	Wghse.	2	220	1150
1	30	W.E.	2	220	1200
2	25	G.E.	2	220	1200
1	25	Fbks.	3	220	1200
1	20	Watson	3	220	1200
4	20	G.E.	2	220	1200
1	15	Wghse.	2	220	1120
1	15	Watson	3	220	1200
3	15	G.E.	2	220	1200
3	15	Wghse.	2	220	1700
2	15	Wagner	2	220	1700
1	12	G.E.	2-40 cy.	220	1200
3	10	G.E.	2	220	1200
1	10	G.E.	3	220	1700
2	10	Wghse.	2	220	1700
1	10	Wghse. S.L.	2	220	1700
1	10	G.E.	3	440	900
1	10	G.E., K.	2	220	720
2	7½	Wghse.	2	220	1200
2	7½	G.E.	3	220	1200
1	7½	G.E., K.	2	220	720
4	5	G.E.	3	220	1700
6	5	G.E.	2	220	1700
4	5	G.E.	3	220	1200
14	3	G.E.	3	220	1700
6	3	G.E.	2	220	1200
12	3	G.E.	3	220	1200

Alternating Current, Single Phase

No.	H.P.	Make	Volts	Speed
1	20	Wagner	110/220	900
1	15	Century	110/220	1150
1	15	Wagner	110/220	900
1	10	Wagner	220	1700
1	7½	Wagner	230	1750
3	5	Century	220	1700
2	5	Wagner	220	1700
8	5	G.E.	110/220	1800
1	5	Bell	110/220	1800
1	5	W.E.	220	450
1	2	Century	110/220	1700
1	1	G.E.	110	1700 Var.
35	¼	Wghse.	110	1150
42	¼	Wghse.	110	1700

Direct Current Motors and Generators

No.	H.P.	Make	Volts	Speed
1	150	Milwkee.	220	500
1	100	Milwkee.	220	550
2	100 KW.	C. & C.	240	250
1	60	Strvnt.	250	427/495 Var
1	50 KW.	Wghse.	230	975
1	55	G.E.	220	845
1	45 KW.	G.E.	115	600
1	45	C. & C.	550	800
1	45	Strvnt.	250	612
1	40	C. & C.	220	750
1	35	C. & C.	220	900
1	35	C. & C.	125	800
2	34	Sprague	220	800
1	30	G.E.	500	750
1	30	G.E.	220	800
2	30	G.E.	500	750
1	25 KW.	C. & C.	250	900
1	25	G.E.	220	635
1	25	G.E.	220	1200
1	25	G.E.	250	600
3	25	Am. Eng.	220	700
1	25 KW.	C. & C.	115	750
1	25	G.E.	220	675
2	20	W.E.	220	800
1	20	G.E.	220	1100
1	20	C. & C.	500	1120
1	20	C. & C.	500	1100
1	20	C.W.	115	1000
2	20	G.E.	220	750
2	20	G.E.	220	1100
1	17½ KW.	G.E.	220	1200

Direct Current Motors and Generators

No.	H.P.	Make	Volts	Speed
1	15	C. & C.	220	125
1	15	G.E.	125	450
1	15	Wghse.	220	1675
1	15	G.E.	240	1000
2	15	W.E.	115	1100
1	15	G.E.	500	1200
1	15	C.W.	500	1200
1	15	C. & C.	115	750
1	15	G.E.	115	1200
1	15	G.E.	550	1850
1	14 KW	G.E.	150	1500
1	12	W.E.	115	1000
1	10	Wghse.	500	1200
1	10	Stand.	500	1375
1	10	Reliance	220	1400
2	10	G.E.	110	1100
1	10	Al. Chlms.	220	300
1	10	G.E.	500	650/1950
6	10	G.E.	500	450/900
4	10	G.E.	230	450
1	10	Stand.	230	1225
3	10	C. & C.	230	500
1	10	G.E.	230	460/920
2	10	G.E.	220	450/900 Var.
2	10	Roth	60	900
2	10	G.E.	220	450/900 Var.
2	10	C. & C.	220	1100
1	7½	G.E.	230	500/1500
1	7½	G.E.	550	B. Gr. 1350
2	7½	C. & C.	220	1100
1	7½	G.E.	220	500/1500 Var.
1	7½	G.E.	220	500/1500 Var.
1	7½	G.E.	550	650/1950
1	7½	W.E.	115	1525
1	7½	Wghse. New	220	1100
3	7½	G.E.	220	1650
2	5	G.E.	550	B.Gr. 1350
5	5	Wghse.	220	1100
1	5	G.E.	110	1100
1	5	C. & C.	220	1100
1	5	C. & C.	220	1700
1	3	Roth	220	2200 Buff
2	3	G.E.	110	1625
2	2.2 KW.	G.E.	50	515
2	2	G.E.	110	1625

BOOSTER SETS, SPECIAL VOLTAGE PLATING, DYNAMO ETC ETC.

NATHAN KLEIN & CO., INC., Biggest Stock in the East Office, 203 Centre St., N.Y.C.

Warehouses: 32 Howard St.; 205 Lafayette St.; 140 Baxter St.

What Have You For Sale?

FOR SALE

One 100 KW. General Electric D.C. 110 volt generator, direct connected to an 11 x 20 x 14 tandem compound Ideal Self Oiling center crank automatic engine, complete with marble switchboard.

Also one 25 KW. Westinghouse D.C. 110 volt generator, direct connected to an 8½ x 10 Ideal Self-Oiling center crank automatic engine, complete with marble switchboard.

These machines have only been in use a short time, and are in perfect condition. They are on the foundations at our plant here and can be started up and seen in operation at any time. This is a chance for a great bargain.

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Big Four Ice & Cold Storage Company
WACO, TEXAS

We are constantly in the market for large generating units, motors, etc.

WE MAINTAIN THE

Largest Electrical Repair Plant in the United States and Rebuild and Overhaul All Types of Electrical Apparatus

I. R. NELSON 1 Bond St., Newark, N. J.

IMMEDIATE DELIVERY

1—150 Kw., 250 volt D.C. Burke Turbo Generator.
2—100 Hp., 3 ph., 25 cy., 440 volt Allis-Chalmers, 720 r.p.m.
1—75 Kw., 250 volt Burke 540 r.p.m.
23—10 Hp., 230 volt D.C. Crocker-Wheeler Type CM, Size 101, 825 r.p.m.

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Miller-Owen Electric Company, Inc.
Rebuilt Electrical Machinery
Pittsburg, Pa.

On December 1st, 1916, we changed our electric power from D. C. to A. C. and now offer the following for sale, ready for immediate shipment:

1 D. C. Westinghouse Generator, 85 K.W., 250 Volts, 340 Amperes, 750 R.P.M., Pulley 22" x 19" Base Plate. Accessories: Switchboard 4' x 5', Ammeter, Volt Meter, Switch and Circuit Breaker.

1 D. C. Westinghouse Motor, No. 13 L Type S. Shunt Wound, 100 H.P., 220 Volts, 375 Amperes, Pulley 27" x 18", 625 R.P.M. Accessories: Base Plate, Starting Box and Switch.

WALL ROPE WORKS, Inc. BEVERLY, N. J.

Alternating Current Motors—Brand New

20 h.p. Fairbanks Morse 1200 speed 60 cycle 2 and 3 phase 220 and 440 volts. Prices 15% less than new prices.

Large stock of alternating current motors, direct current dynamos, motors, etc.

25 K.W., 75 K.W. and 175 K.W. direct connected direct current sets.

When in the market to buy or sell electrical machinery consult us.

R. SCHEINERT CO., 125 N. 3rd St., Philadelphia, Pa.

FOR SALE

One 100-hp. Walrath gas engine, 12 x 12 x 12, friction clutch, pulley, magneto, outboard bearing.

Two 100-hp. Turner-Fricke gas engines, direct-connected to 67½-kw., 250-d.c.-volt generator, complete.

All second-hand in good operative condition. Priced low.

All the above for $2,800.00.

Latshaw Machinery Company Pittsburgh, Penna.

SEARCHLIGHT SECTION

TRANSFORMERS

60 and 25 Cycle-Single Phase

60 CYCLE

6—1667 Kva. Gen. Elec., OI WC, 30,000/60,000 volts primary, 12,000/6,000 volts secondary, with taps for 11,000 or 10,000 volts.
4—667 Kva. Gen. Elec., OI WC, form E1, 7633/22900/39600 volts primary "Y" connection, 2200 volts secondary.
3—600 Kva. Gen. Elec., OI SC, type BITQ, 8000/7000/6400 volts primary, 440/220 volts secondary.
3—500 Kva. Gen. Elec., OI SC, type H, 65,000/60,000 volts primary, 2300/2000 volts secondary.
6—500 KW. Westg., OI SC 2200 volts primary, 440 volts secondary.
2—375 KW. Wagner, OI WC, 4400/2200 volts primary, 220/110 volts secondary.
1—375 KW. Westg., OI WC, 2200/1100 volts primary, 220/110 volts secondary.
3—375 Kva. Westg., OI SC, 2300 volts primary, 575 volts secondary.
3—375 KW. Gen. Elec., OI WC, 9600 volts primary, 550/575 volts secondary.
4—350 Kva. Gen. Elec., OI SC, type H, 33000/13200/6600 volts with extra taps on secondary.
3—200 KW. Gen. Elec., OI SC, 2300 volts primary, 125/157½ volts secondary.
3—200 KW. Maloney, OI SC, type C, 10,500/11,000/12,000 volts primary, 2400/2300 volts secondary.
3—150 Kva. Pittsburgh, OI SC, 12,000 volts primary, 2400 volts secondary, with two 5% taps on high tension side.
2—127 KW. Westg., OI SC, 11,800/11,010 volts primary, 400 volts secondary.
3—100 Kva. Westg., OI SC, type S, 2200/1980 volts primary, 488/244 volts secondary.
3—100 Kva. Allis-Chalmers, 2200 volts primary, 240/480 volts secondary.
3—100 KW. Westg., 2200 volts primary, 240/480 volts secondary.
3—100 KW. Gen. Elec., OI SC, type H, 6600 volts primary, 230/240 volts secondary.
4—100 Kva. Allis-Chalmers, OI SC, 2200 volts primary, 480/240 volts secondary.
2—100 Kva. Westg., OI SC, type S, 2400 volts primary, 250/115 volts secondary.
6—100 Kva. Westg., OI SC, 6600/4400—440/220 volts.
6—100 Kva. Gen. Elec., OI SC, type H, form RP, 6600/6270/5940 volts primary, 460 volts secondary.
6—100 KW. Westg., OI SC, 11,000 volts primary, 391 volts secondary.

60 CYCLE

3—100 Kva. Gen. Elec., OI SC, type H, 20,000 volts primary, 2300 volts secondary.
3—75 KW. Westg., OI SC, 2300 volts primary, 220/440 volts secondary.
1—75 KW. Gen. Elec., AB, 2250 volts primary, 375 volts secondary.
3—50 KW. Allis-Chalmers-Bullock, OI SC, 2200/1100 volts primary, 440/220 volts secondary.
2—50 KW. Allis-Chalmers, OI SC, 2200/1100 volts primary, 220/110 volts secondary.
1—50 KW. Westg., OI SC, type OD, 2300 volts primary, 220/110 volts secondary.
3—40 KW. Gen. Elec., OI SC, type H, 575 volts primary, 115/230 volts secondary.
3—40 Kva. Gen. Elec., OI SC, type H, 1100/2200 volts primary, 110/220 volts secondary.
6—30 KW. Gen. Elec., OI SC, 2200 volts primary, 110/220 volts secondary.
6—25 KW. Westg., AB, 13,200 volts primary, 220 volts secondary.

25 CYCLE

6—750 Kva. Gen. Elec., OI SC, 2200/4400/2090/1980 volts primary, 281/488 volts secondary, "Y" connected.
6—560 Kva. Gen. Elec., OI SC, 2200 volts primary, 220 volts secondary.
6—300 KW. Gen. Elec., OI WC, 22,000 volts primary, 2300 volts secondary.
3—185 KW. Gen. Elec., OI SC, 33,000/29,700 volts primary, 430/143 volts secondary.
3—150 Kva. Gen. Elec., OI SC, 6600 volts primary, 115/230 volts secondary.
4—110 KW. Stanley, OI SC, 13,500/15,000 volts primary, 370 volts secondary.
6—100 KW. Gen. Elec., OI SC, type H, 6000/5150 volts primary, 176 volts secondary.
2—100 KW. Westg., OI SC, 6000 volts primary, 178 volts secondary.
3—90 KW. Gen. Elec., OI SC, type H, 6000/5340 volts primary, 350 volts secondary.
3—50 Kva. Gen. Elec., OI SC, 6600 volts primary, 460 volts secondary, with 5% reduced capacity tap on high tension side.
3—50 KW. Gen. Elec., OI SC, type H, form A, 12,500 volts primary, 2300 volts secondary.
3—30 KW. Gen. Elec., OI SC, type H, 2080/2300 volts primary, 230/460 volts secondary.

MAC GOVERN AND COMPANY, INC.
114 Liberty Street **New York City**

We are prepared to
Purchase or Finance
Public Utility Properties
with records of established earnings.
Correspondence is invited.
Stanwood, Taylor & Co.
Investment Bankers
111 W. Monroe Street, Chicago, Ill.

FOR SALE

One Direct Connected Set 30 KW. CC Generator, Direct Current, 125 Volts, with 10 x 10 Chuse Engine. Immediate delivery.

GILBERT D. VON PHUL
Hibernia Bank Bldg. **New Orleans, La.**

FOR SALE

9,000 feet 500,000 CM and 21,000 feet 1,000,000 CM duplex concentric, paper insulated, lead covered **cable,** 600 volt working pressure, equipped with pressure wire for reading voltage at feeder end.

This cable will be pulled out of cable ducts in a short time.

Louisville Gas and Electric Company
311 West Chestnut St., Louisville, Ky.

Two 500 K. W. Generators

2—750 h.p. Corliss cross compound engines, each equipped with a reheater, jet condenser and fly wheel; direct connected to a 500 K.W. Stanley 60 cycle, 2 phase, 230 volt generator.

Both outfits are in excellent condition and are ready for immediate shipment.

Location—New York State.

For further information address
Box 3602, Elec. World.

MOTORS - DYNAMOS

Write us what you want to buy or sell

SCHWARTZ & LAND
207 Centre Street **New York**

Little "Want Ads" in the
Searchlight Section
bring BIG results

DIRECT CONNECTED SETS FOR SALE

15 K.W. Sturtevant, 125 volt to 8 x 8 Sturtevant automatic center crank engine.
30 K.W. C. & C. 230 volt to 9 x 12 Skinner automatic center crank engine.
35 K.W. Bullock 125 volt to 11 x 10 Ideal automatic center crank engine.
50 K.W. General Electric 2 phase, 60 cycle, 240 volt revolving field type "AQB" generator to 12 x 12" Skinner automatic side crank engine. All guaranteed.

JAS. A. GRAHAM, 30 CHURCH STREET, N. Y.

SEARCHLIGHT SECTION

WE HAVE JUST PURCHASED AND OFFER FOR SALE the following equipment located at the plant of the Pennsylvania Utilities Co., at Easton, Pa.

A. C. Motor

1—130 H.P. Westinghouse type "C," 2 phase, 60 cycle, 2200 volt motor, 850 r.p.m.

Belted Generators, D.C.

1—250 K.W. Western Electric, 250 volt, 1000 amp., 450 r.p.m.
1—150 K. W. 500 volt Westinghouse Railway Generator.

A. C. Generator

1—120 K.W. 220 volt, 60 cycle Westinghouse Generator, 2 phase, 720 r.p.m.

Booster Set

1—Booster Set, consisting of 135 H.P. 550 volt, D.C. Motor, direct connected to 800 amp. 110 volt Bullock Generator, 600 r.p.m.

Engines

1—800 H.P. McIntosh & Seymour Tandem compound double Engine, size 14½" x 26" x 22".
1—3-cylinder General Electric 800 H.P. Vertical Automatic, size 24" x 40" x 18".
2—400 H.P. General Electric compound Vertical Automatic Engines, 16½" x 18½" x 18".
2—150 H.P. 14½ x 15 Armington-Sims Engine.
2—100 H.P. 13 x 12 Armington-Sims.

Arc Lamps

600 Arc Lamps

Transformers—60 Cycle, Single Phase

	Volts Primary	Volts Secondary
1—25 K.W. General Electric	1040-2080	104-208
3—20 K.W. Wagner	1000-2000	104-208
3—15 K.W. General Electric	1040-2080	104-208
1—15 K.W. Wagner	1000-2000	104-208
1— 5 K.W. Wagner	1000-2000	104-208
1— 5 K.W. General Electric	1000-2000	104-208

Conveyor

1—Coal Bucket Conveyor.

Belting

1—36" triple Leather Belt, 100' long.
Several smaller size belts, 20", 18", 12", 10" double.

Condensing Pumps

1—Worthington Independent Duplex Pump, size 12 x 7 x 15.
1—Dean single condensing Pump, 10 x 18 x 24.

The above material can be examined by applying to The Gibney Iron & Steel Co. of Phillipsburg, N. J. (directly across the river from Easton, Pa.) or by addressing below.

FRANK TOOMEY, Inc.

127-129-131 North Third Street **Philadelphia, Pa.**

FOR SALE

Electric Light Plant for Sale

In good growing town in Montana, gross earnings for November, $1,000. Corliss engines 2200 volt equipment. Price $16,000, of which $5,500 may be on time. Box 3483, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

Circular Loom Bargain

We have in stock about 2000 feet of 2-inch flexduct in 50-foot lengths, which we offer, subject to prior sale, at 16 cents per foot, f.o.b. Chicago. Queen City Electric Co., 2944-46 W. Lake St., Chicago, Ill.

Generators for Sale

50 kw., 70 kw. and 100 kw., 2300 volt, 60 cycle, 3 phase generators, each complete with exciter and other accessories. In excellent condition and fully guaranteed. V. M. Nussbaum & Company, Fort Wayne, Ind.

120 KW. Alternator for Sale

120 kw. (old rating 100 kw.) General Electric, 900 r.p.m., 2300 volts, 3 phase, 60 cycles. Alternator as good as new. Complete with field rheostat and pulley, but no exciter. Can ship Jan. 15th. Installing larger unit. S. B. Wiggins, 2276 W. Grand Blvd., Detroit, Mich.

For Sale

Fine water power for sale in North Carolina, including 75-barrel roller mill, corn mill and feed mill in good grain country; everything necessary for an up-to-date mill. Located in a town of ten thousand inhabitants. Prices right and terms easy. Address Box 3310, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

FOR SALE

Engine for Sale

225 hp. Diesel oil engine. Unit is in first class condition. Gardner Electric Light Company, Gardner, Mass.

Generating Units for Sale

We have for short delivery, several new 60 cycles, 3 phase, 2300 volts, generating units for sale ranging from 180 kva. to 450 kva. capacity and directly connected to Uniflow engines. Wire us your requirements. H. A. & G. X. Chuse, Mattoon, Ill.

60 Cycle Transformers for Sale

2—15 kw., 6600/5700-110/220/440, sgle ph.
1—20 kw.,6600/13,200-110/220/440, sgle ph.
1—25 kw., 13,200-110/220/440, single ph.
1—15 kw., 6600-110/220/440, three ph.
1—30 kw., 6600-110/220/440, three ph.
V. M. Nussbaum & Co., Fort Wayne, Ind.

Engines for Sale

1—24 x 48 Allis-Chalmers Corliss Engine.
1—30 x 60 Allis-Chalmers Corliss Engine, fitted with tail rod.
1—23 x 48 Nordberg Corliss Engine.
All equipped for rope drive. Now running and in first class condition. Can be released May 1, 1917. The Oval Wood Dish Co., Traverse City, Mich.

Generating Plant for Sale

550 D. C. generating plant, in first class condition, which we will sell at a very low price, together with boiler, switchboard, and everything complete.

M. K. FRANK
Frick Bldg. Pittsburgh, Pa.

FOR SALE

Furnace Blower and Pump for Sale

One Koerting steam furnace blower for 150 hp. boiler. One Deming triplex pump for 150 hp. Both good as new. D. A. Steiner, Supt., Centralia, Kan.

Stock-Taking Time

Now is the time to turn the surplus stock of metals you have on hand into cash. We buy all grades of scrap metals, small lots as well as large lots. Write us today and tell us what you have and we will be pleased to quote you prices. National Metal & Rubber Company, 30-31 India Wharf, Boston, Mass.

Motor for Sale

1—15-HP. Northern variable speed D. C. Motor, V. 220, RPM. 325-650, without rails or pulley, but including starter. Newly rewound and overhauled and in A-1 condition. Price $200.00 f.o.b. Marvel, Ala. Roden Coal Company, Marvel, Ala.

Generator for Sale

300 K. W. Generator in thoroughly good condition, 550 volt, compound wound, belted type G. E., 3 bearing 6 pole machine. 400 R.P.M., ¾" stock in commutator. Pulley 43" x 37" face, complete with rails and field rheostat. Hanovia Chemical & Mfg. Co., Newark, N. J.

Transformers for Sale

3 100 kw. each, 2200, 120, 240-volt, 60 cycle, single phase, General Electric, latest type, with oil; first-class order. 1 50 hp., 900 r. p. m. new General Electric slip ring motor, 60 cycle, 3 phase, complete; this motor never out of crate. Immediate shipment on above. Liberty Light & Power Co., Richmond, Ind.

SEARCHLIGHT SECTION

Get your Wants into the Searchlight

ADVERTISING RATES

Under "Positions Wanted," including Salesmen looking for new connections, Evening Work Wanted, etc., undisplayed advertisements cost **two cents a word,** minimum charge 50 cents an insertion, **payable in advance.**

Under "Positions Vacant," including Agents and Agencies Wanted, Representatives Wanted, Salesmen Wanted, Partners Wanted, Business Opportunities, Employment Agencies, and Miscellaneous For Sale, For Rent and Want ads; also Auction Notices, Receivers' Sales, Machinery and Plants For Sale or Wanted, undisplayed advertisements set solid in one paragraph, cost **three cents a word,** minimum charge $1.50 an insertion.

Machinery advertisements (undisplayed) set with a paragraph for each item, or tabulated, will be charged at 25 cents a line.

If replies are in care of any of our offices, allow five words for the address.

All advertisements for bids (Proposals) cost $2.40 an inch.

ADVERTISEMENTS IN DISPLAY TYPE

cost as follows for single insertions:

1/16 p. (1 1/16 x 3 3/8 ins.)	$6.25	1 in. (1x2 1/16 ins.)	$4.00
1/8 p. (2 5/8 x 3 3/8 ins.)	12.50	4 inches (4x2 1/16 ins.)	15.20
1/4 p. (5x3 3/8 or 2 5/8 x 7 ins.)	25.00	8 inches (8x2 1/16 ins.)	29.20
1/2 p. (10 1/4 x 3 3/8 or 5x7 ins.)	50.00	15 inches	52.50
1 page (10 1/4 x 7 ins.)	30 inches		$100.00

For space to be used within one year, to be divided to suit requirements of advertiser, provided some space is used at least once a month following first insertion:

3 pages	$88 a page	18 pages	$68 a page
6 pages	80 a page	26 pages	64 a page
12 pages	72 a page	52 pages	60 a page

In replying to advertisements, do NOT enclose original testimonials, or anything that you may want returned. State your qualifications in as concise and neat a manner as you can and enclose COPIES of testimonials. In machinery ads, use a local name or address if possible so that readers can wire direct and get quick replies.

FOR SALE

Cable for Sale

383' New 1,000,000 C. M. W. P. Cable.
135' New 500,000 C. M. W. P. Cable.
Dewey Portland Cement Co., Dewey, Okla.

Direct Connected Unit for Sale

50 K.W., 230 volt Triumph generator, D. C., and Skinner engine; 4—5 H.P., 2-phase Westinghouse motors, CCL, 1700 R.P.M., 60 cycles, 220 volt; many other motors. J. W. Adams, 130 N. 12th St., Philadelphia, Pa.

Diesel Engine for Sale

A 120 hp., 3 cylinder, 12 x 18, Busch-Sulzer Bros. Diesel engine in perfect conditions for use. Price $4,000. Critical inspection invited. No brokers. Atlantic Light & Power Co., Coeymans, N. Y.

Motors for Sale

220 volt motors for sale, 1 75 hp., 2 phase, 60 cycle.
1 15 hp., 2 phase, 60 cycle.
1 20 hp., 3 phase, 60 cycle.
1 20 hp., direct current.
National Elect. Exch., Aurora, Ill.

Motors for Sale

Three 15-hp., 1500-r.p.m. motors, one 20-hp., 850-r.p.m. motor, all Diehl interpole motors, less than five years old, in first-class condition. Address Warren B. Lewis, 740 Grosvenor Building, Providence, R. I.

Center Crank Engine for Sale

One 7 x 8 Chuse Engine Co. self oiling, high speed, automatic center crank engine, mounted on subbase, with 2 belt wheels, 40 x 7 in., 2 in. steam connection. Floor space 3 ft. x 6 ft. 6 in. Splendid condition. Price $200. Brown-McDonald Mfg. Co., St. Louis, Mo.

Rice & Sargent Engine

Horizontal, simple non-condensing, releasing gear, belted type. Indicated horsepower, 280 at 25% cut-off; 375 at 60% cut-off. Cylinder 16 in., stroke 36 in.; r.p.m. 120, steam pressure 130 lb. Only six years old and in daily operation. If you can use this fine engine write at once to Box 3603, Elec. World.

Copper Bus Bar for Sale

1	Length	5"	x 1/2"	21' 6"
1	Length	5"	x 1/2"	20'
1	Length	5"	x 1/2"	18' 6"
2	Lengths	3"	x 1/2"	4' 6"
2	Lengths	3"	x 1/2"	4'
2	Lengths	3"	x 1/2"	3' 6"

Total Weight—719 lb.
Penn. Central Light & Power Co., Altoona, Pa.

FOR SALE

Generators for Sale

One 312 kva. Westinghouse generator, 60 cycle, 2300 volt, 100 r.p.m., direct connected to Frick compound Corliss engine; one 125 kva. Minneapolis generator, 60 cycle, 2300 volt, 180 r.p.m., direct connected to Minneapolis 4-valve engine; one 75 kva. Minneapolis generator, 60 cycle, 2300 volt, 257 r.p.m., connected to a 4-valve Chuse engine. All in good condition. Can supply condensing plant with compound Corliss. Address P. O. Box 188, Lawton, Oklahoma.

Central Station Apparatus for Sale

2—8 hp. upright boilers.
1—Westinghouse 250 hp. producer and Scrubber.
2—Westinghouse gas engines—57 hp. each.
2—Westinghouse air compressors.
4—Compressed air tanks.
1—2 kw. Westinghouse exciter.
2—Thomson-Houston alternating current generators—class A-6, 35 kw., 1000 volt, 133 cycle.
1—Westinghouse 50 kw., generator, 60 cycle.
Citizens Gas, Electric & Power Co., Nantucket, Mass.

BUSINESS OPPORTUNITIES

Contracting Business for Sale

Excellent opportunity to step into Old Established Contracting and Fixture Business in live town of 25,000 in Middle West. Can be handled with $2,500 cash. Doing a good clean business and making money. Will bear closest investigation. Box 3501, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

Wanted—Public Utilities to Sell

Or we will finance properties on a 5 per cent interest bond issue. The single plant owner or the syndicate operator can realize without publicity as we have a large number of buyers whose combined capital is over one billion dollars. We submit each property to but one purchaser and make no promiscuous offerings. G. Y. Bonus, 140 South Dearborn St., Chicago.

MISCELLANEOUS WANTS

Belting and Motors Wanted

Leather belting and motors. P. Pettler & Son, Beaver Falls, Pa. (Pittsburgh District.)

Electric Generator Wanted

One 225 to 250 K.W. direct current 250 v. electric generator suitable for 200 R. P.M

The Griscom-Russell Co.
90 West Street New York, N. Y.

MISCELLANEOUS WANTS

Generator Wanted

100 to 200 kva., 3 phase, 60 cycle, 750 r.p.m. or less. Box 3346, Elec. World. 1570 Old Colony Bldg., Chicago, Ill.

Will Purchase

A gas, electric or combination gas and electric property in small city. Write to-day, giving full particulars, to A-L. Box 3559, Elec. World.

Braiders Wanted

9—32 carrier N.E.B. Co. Braiders. State condition, term in use and price. Address Driver-Harris Wire Co., Harrison, N. J.

Motor Wanted

1—350, 1—75 hp., 3 phase, 60 cycle wound rotor motor. D. L. Keiser, LaSalle Building, St. Louis, Mo.

Motor Wanted

1—25 hp., 1200 r.p.m., 220 volt, 3 phase, 60 cycle, Squirrel Cage or internal resistance type motor. N. E. Machine & Electric Co., 31 Bayley St., Pawtucket, R. I.

Motors Wanted

We are in the market for several A.C. and D.C. motors, and also some plating dynamos, any size or make. Write us what you have to offer. Schwartz & Land, 207 Centre St., New York City.

Electricians and Armature Winders

Send $1 for 14 blue prints of motor windings, 10 A.C., single, two and three phase, and 4 D.C., or set of 20 A.C., 4 D.C. and 4 rotary converter drawings, $1.60. Winding made easy. Martin Elec. Co., 329 Irvington Place, Denver, Col.

Turbo-Generating Set Wanted

3 phase, 60 cycle, turbo-generating set for 200 lb. steam pressure, having a capacity of 5000 to 10,000 kw.; must be in first-class order; give particulars, price and state how soon it can be delivered. Address R. S. Kelsch, Power Building, Montreal.

WANTED

Oil Engine and Generator Units

75 to 150 KW Capacity. Must be first class. Give full specifications.

Box 3545, Electrical World
1570 Old Colony Bldg. Chicago, Ill.

SEARCHLIGHT SECTION

PROPOSALS

Bids open January 25, 1917.

NEW STREET LIGHTING SYSTEM AND FURNISHING OF ELECTRIC CURRENT

NEW BRIGHTON, PA.

Sealed proposals, marked on the outside of envelope: "Proposals for the New Street Lighting System and the Furnishing of Electric Current" will be received by the Light Committee of the Council of the Borough of New Brighton, Pa., until 12 noon, Eastern Standard time, of the 25th day of January, 1917.

Plans and specifications can be secured from said Light Committee or can be seen at the office of the Consulting Engineer, H. O. Swoboda, Empire Building, Pittsburgh, Pa.

The Borough of New Brighton, by its Light Committee, reserves the right to reject any and all proposals.

THE BOROUGH OF NEW BRIGHTON, PENNSYLVANIA,
H. C. MOLTER,
Chairman of Light Committee.

TREASURY DEPARTMENT, Supervising Architect's Office Washington, D. C., December 12, 1916.—Sealed proposals will be opened in this office at 3 p. m., January 11, 1917, for a new refrigerating machine in the United States post office and courthouse at Augusta, Ga., in accordance with the specification, copy of which may be had at this office or at the office of the custodian, Augusta, Ga., in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

POSITIONS WANTED

CHIEF electrician, technical education; 9 years' experience, high tension systems, construction, maintenance and operating; now employed; prefer large office building or municipal plant. Box 3582, Elec. World.

CHIEF engineer desires to make change; 20 years' experience in steam and electrical plants, 12 years as chief engineer. Position in a mill plant or hydro-electric preferred; location in Northeast, Massachusetts preferred; hold first-class engineer's license for Massachusetts; references; age 42. Box 3577, Elec. World.

ELECTRICAL engineer, technical graduate; age 29; eight years' experience testing drafting, steam turbines, lighting and power work; last year in factory design; wants position where initiative and hard work are recognized. Box 3427, Elec. World.

ELECTRICAL engineer, University of Michigan graduate, 29. Wants position with large central station or superintendent of small system. Employed, but desires change. Box 3414, Elec. World, 935 Real Estate Trust Bldg., Philadelphia, Pa.

ELECTRICAL engineer, age 30, G. E. test and 7 years in responsible positions on all classes of construction, power station layout and drafting; seeking permanent position. Address Box 3533, Elec. World, 935 Real Estate Trust Bldg., Phila., Pa.

ELECTRICAL engineer desires change of location. Twenty-seven; married. College graduate in Electrical Engineering. Experienced in design and installation of switchboards, high tension substations, transmission lines, power plants. Qualified to take charge of drafting department or assistant to construction engineer, large power company. Minimum salary, $1,500. West preferred. Box 3593, Elec. World.

POSITIONS WANTED

ELECTRICAL graduate, age 24; three years' experience operating and construction; two years as engineer in charge of layout and installation of power and lighting equipment for large milling company; desires position with central station or progressive business organization as superintendent or maintenance engineer; A-1 references; salary open, subject to correspondence. Box 3580, Elec. World.

ELECTRICIAN, first class helper, strong young man, 21, with tools; mechanically bound; one willing and who can work; wants steady position in Greater New York only. Salary moderate. Box 3460, Elec. World.

ENGINEER, fifteen years' experience in the manufacture and sale of electrical apparatus, will be open for engagement February 1st. Qualified for position as sales or factory manager or other work requiring executive ability and initiative. Box 3492, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

ENGINEER desires position with lighting and power company in sales or engineering departments; age 24, 3 years' operating experience; 2 years in charge of layout and installation of power and lighting equipment for large manufacturing concern; A-1 references. Box 3581, Elec. World.

ENGINEER, experienced in design and manufacture of electrical apparatus, open about Feb. 1 for position of chief engineer or superintendent of small factory; salary moderate. Box 3574, Elec. World, 935 Real Estate Trust Bldg., Philadelphia, Pa.

ENGINEER in responsible charge of public utility valuation and regulation work of the most important character, wishes to find positions for a number of high class assistants experienced in the valuation, accounting and management of railroads, gas, electric light, water and steam heating plants. The salaries of the assistants referred to for a number of years have been from $2,500 to $4,200 a year, but the work upon which they are engaged is nearing completion. Box 3547, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

MECHANICAL-Electrical engineer, experienced in installation and maintenance electric power plants, industrial haulage systems, and industrial applications of electrical machinery in general. Technical education. Associate member American Institute of Electrical Engineers. For past four years engineer in charge electrical and mechanical departments of a number of coal mining companies. I desire to change to a broader field. Box 3573, Elec. World, 935 Real Estate Trust Bldg., Philadelphia, Pa.

SHOP foreman, American, 43, 20 years' experience in maintenance and repairs A.C. and D.C. windings, transformers, switch and panel boards, etc. Cost estimator. Now in charge repairs, Panama Canal. Wants position in States. References. State salary. F. N. Weidner, 19th and Chestnut Sts., Chester, Pa.

Export Engineer

Export engineer. Electrical engineer, German graduate with thorough broad professional education and 5 years' experience in engineering and foreign departments. Perfect knowledge of Spanish American trade requirements and Spanish language. Employed at present, desires position with good opportunities for advancement. Foreign engineering or sales department preferred. Box 3601, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

POSITIONS VACANT

DRAFTSMAN experienced in heavy power plant, mechanical designing. State age, experience and salary. Box 3600, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

ELECTRICAL draftsman wanted on power and high voltage substation designing. Good opportunity for right man. Give reference. Box 3562, Elec. World.

ELECTRICAL engineers for designing switchboard details, fittings and smaller panel mounted devices. Give age, experience and salary expected. Address Box 3585, Elec. World, 935 Real Estate Trust Bldg., Philadelphia, Pa.

FIRST class armature winders, also two commutator experts. Steady work, ideal conditions. Apply Gregory Electric Co., Sixteenth and Lincoln Sts., Chicago, Ill.

MECHANICAL and electrical engineer, for experimental and testing work. Technical graduate with two or three years' experience preferred. Exceptional opportunity for advancement with rapidly growing concern developing lines of small intricate machines and electrical devices. State experience and education fully. Box 3583, Elec. World.

OPERATING engineer, familiar with central station plant, which consists of all modern equipment; a knowledge of high tension transmission line operation is essential; a splendid opportunity for the right men to advance with a rapidly growing company. State age, reference, education, experience, and salary expected. Box 3599 Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

SEVERAL skilled electrical instrument makers, first-class men for instrument and meter calibration wanted; write fully, giving detailed experience and wages desired. Roller-Smith Company, Bethlehem, Pa.

SWITCHBOARD engineer with technical education competent to design high power A.C. boards. State age, experience and salary expected. Address Box 3586, Elec. World, 935 Real Estate Trust Bldg., Philadelphia, Pa.

WANTED—A man who has had experience in the testing of electric meters, also setting and removing meters and trouble work in general; will be able to pay a salary of $75 per month to the right man; in making application, state age and experience; town of 16,000 in Middle West. Box 3575, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

WANTED—Foreman experienced in all branches of strip and tubing machine rubber insulated wire and cable manufacture. State details of former experience; how soon available and compensation expected. Box 3423, Elec. World, 935 Real Estate Trust Bldg., Phila., Pa.

YOUNG technical graduates wanted for test floor work by a large manufacturer of electrical machinery. Broad training and exceptional opportunities for qualified men. Give full particulars regarding education and practical experience in first letter. Box 911, Pittsburgh, Pa.

AGENTS AND SALESMEN

Salesman Wanted

Salesman, thoroughly experienced in central station work. Address Box 1102, Gary, Ind.

SEARCHLIGHT SECTION

AGENTS AND SALESMEN

Lighting Solicitors Wanted

Good salary and bonuses to first class solicitors. Large growing city in Pennsylvania. Box 3596, Elec. World. 935 Real Estate Trust Bldg., Phila., Pa.

Lighting Salesman Wanted

Experienced lighting salesmen. Write stating age, experience, reference and married or single. Continuous work on salary and commission with large Central Station. Can grant New York interview during the week of Dec. 25th to 30th. Reply to Newman, 74 Main St., Norwalk, Conn.

Will Begin at Bottom

Salesman, 27, engineering graduate, 8 years practical experience electrical and mechanical fields. Will sacrifice salary for opportunity with large manufacturer. Box 3557, Elec. World.

High Grade Salesman

WANTED, high grade salesman having thorough knowledge of electricity preferred. Exceptional opportunity is offered and it is essential to give complete record, state experience and present salary. Box 3592, Elec. World.

Salesman Wants Position

Technical graduate (1915), age 22, desires position as salesman with engineering company. Have had drafting room, power house and selling experience. No bad habits. Give full particulars in first letter. Box 3604, Elec. World, 935 Real Estate Trust Bldg., Philadelphia, Pa.

AGENTS AND SALESMEN

Opportunities in China and Japan

We offer an opportunity to any manufacturer of electrical machineries to extend his business through our export department for Japan and China. Hongo Co., 154 Nassau St., New York City.

New Business Solicitor Wanted

Must be sober, industrious and of good habits and address. Prefer young man not over 26, experienced in conducting house wiring and range campaigns, thoroughly familiar with all types of wiring systems for light, heat and power and competent to estimate on and install same, and take charge of and keep busy a crew of from 10 to 14 men. Give references and state salary expected in first letter. Location Virginia. Box 3591, Elec. World, 135 Real Estate Trust Bldg., Philadelphia, Pa.

Your Advancement

is largely in your own hands—it is doubtful if any one else is worrying over it

Better positions are constantly being secured through small advertisements in the "Positions Wanted" Columns of *Electrical World*.

50 cents for 25 words

EDUCATIONAL

BLISS ELECTRICAL SCHOOL, WASHINGTON, D. C.—Condensed Course in Electrical Engineering, complete in one year. Thorough — practical — scientific, theoretical and applied electricity, mathematics, mechanical drawing and necessary engineering training. No superficial or non-essential studies. Actual instruction, installation and testing. For young men of energy and character. 24th year opened Sept. 27. Write for catalog. Address 129 Tacoma Ave.

METERMEN WANTED to enroll for complete practical course in "Electrical Measuring Instruments and Meters." Endorsed by leading electrical men. Write for booklet, "Instruments and Meters," giving full information. Fort Wayne Correspondence School, 913 Shoaff Bldg., Fort Wayne, Ind.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.—Course in Civil, Mechanical, Electrical and Chemical Engineering and General Science, leading to the degree of Civil Engineer (C.E.), Mechanical Engineer (M.E.), Electrical Engineer (E.E.), Chemical Engineer (Ch.E.), and Bachelor of Science (B.S.). Also special courses. Splendidly equipped new engineering laboratories. Send for catalog to the Registrar.

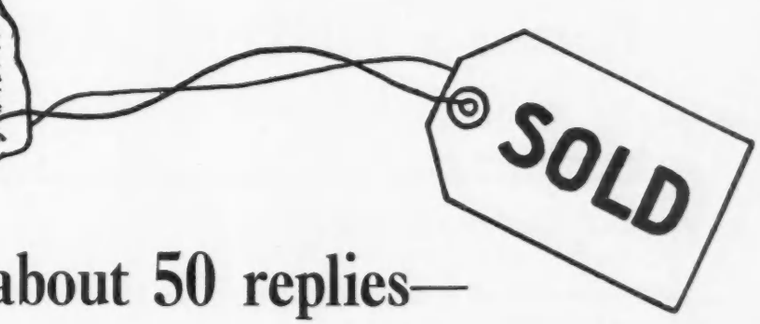
EMPLOYMENT AGENCIES

AMERICAN SERVICE COMPANY, Pittsburgh, Pa., solicits confidential employment records of available electrical, power engineers, master mechanics, draftsmen, designers and construction or industrial electricians. Commercial managers for municipal business. Proposals issued to known and prospective employers everywhere. Records are carried until subscriber is permanently engaged. Records sent to employers for approval preliminary to direct negotiations.

Light Plant for Sale

In a growing town of 1000 near Cincinnati. Cash price $3,850, or $4,000 on time, requiring $2,000 down, balance on terms to suit. This is an exceptional opportunity for a young man to get into this business. Other business requires owners' attention, hence the sacrifice. Box 1135, Elec. World.

— fri- -hines



"We received about 50 replies—

—some of these were from Canada, some from Cuba and one from Panama.

"* * * we could have sold a dozen plants if we had them.

"Your 'Searchlight' advertising certainly brings results and reaches the class of people who are interested in this line.

"Walton Electric Light Co."

The advertisement reproduced above cost only $1.50 an insertion and was published but five times, when the advertisers notified us to stop it as they already "could have sold a dozen plants." This is only one example among many of the selling power of Searchlight Section advertisements.

DO IT NOW!

Get your Wants into the Searchlight

ADVERTISING RATES

Positions Wanted, Evening Work Wanted, 2 cents a word, minimum charge 50 cents an insertion, payable in advance.

Positions Vacant, Salesmen Wanted, Agencies, all undisplayed Miscellaneous ads, Machinery and Plants For Sale (with one line of display heading). 3 cents a word, minimum charge $1.50 an insertion.

All advertisements for bids cost $2.40 an inch.

Advertisements in display type cost as follows for single insertions:

1-16 page, $6.25	1 in. single col., $4.00
1-8 page, 12.50	4 in. sing'e col., 15.20
1-4 page, 25.00	8 in. single col., 29.20

In replying to advertisements, send copies of testimonials, etc., instead of originals.

Your *Own* Electrical World

These are the advantages of being a personal subscriber:

You receive your own copy of Electrical World each week.
You have it when you want it and as long as you want it.
You can keep your own file of the paper for reference.

If you are not a regular subscriber, you probably see the Electrical World from time to time. But, are there not times—and many of them—when you want to read the latest issue and some one else has it? Are there not many other times when you want to refer to an article in a back number, but cannot find that number?

For less than 6 cents a week

you can be a personal subscriber—you can get all the news of the electrical field while it is still fresh and valuable—you can have a constantly growing library of your own on all branches of electrical work.

You will never miss the subscription price, but you will miss a lot of things if you do not get the World.

Better Send Your Order To-Day

before it is forgotten

ELECTRICAL WORLD
239 West 39th Street, New York .....

You may enter my subscription for the Electrical World tc begin at once.

Cross out one of these lines } I enclose $.....herewith.
I agree to send $.....not later than.....
(Please give definite date)

Signed by .....

Address copies to.....

Street Address .....

City .....State .....

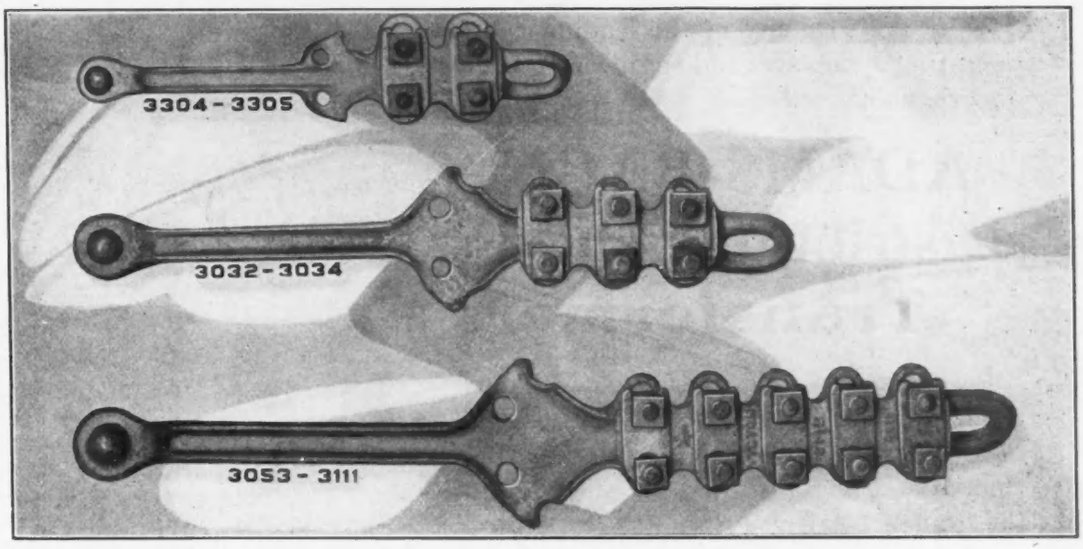
Company .....Position .....

Business of Company.....

Yearly subscription rates: Domestic $3.00, Canadian $4.50, Foreign $6.00

E.W. 12-30-16

A "Victor" Safeguard for Line Construction

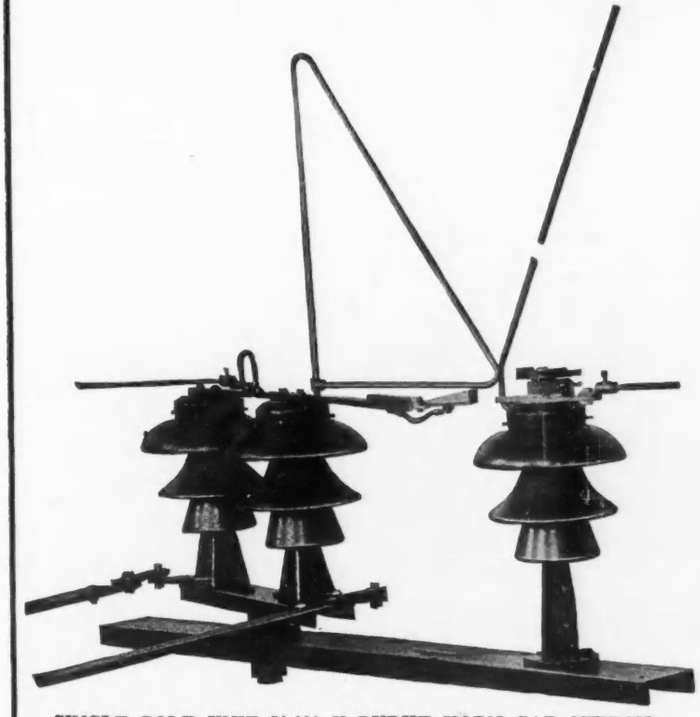


"VICTOR" STRAIN CLAMPS

The response of "VICTOR" *Service* to the pressing demand for a really efficient, easily applied and absolutely dependable *strain clamp* for service at anchorage points of suspension insulator construction. Details on request.

The Locke Insulator Mfg. Co., Victor, N. Y. New York City Office 50 Church St.

"Service Resumption Must Not Wait For Repairs"



SINGLE POLE UNIT 50,000 V BURKE HORN GAP SWITCH

Limit the Trouble Area by

Sectionalizing Power Distribution

with

Burke Horn Gap Switches

The operation of these switches is reliable under all conditions. They are built to open under load, and the copper leaf brush contact protected by a sleet hood makes the switch absolutely weather-proof.

Write for data and catalog

Railway & Industrial Engineering Company

PITTSBURGH, PA.

New York Representative, 2 Rector Street

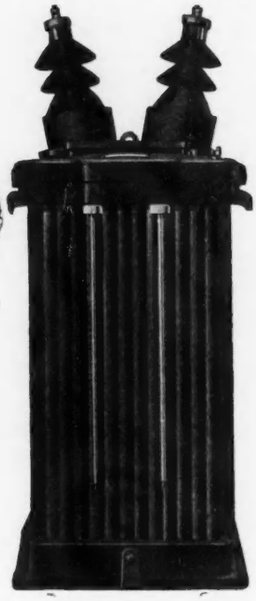
The TRANSFORMERS OF STEADY PROGRESS!

Why are so many of the leading central stations, operating syndicates and engineering firms now using and regularly ordering

ADAMS-BAGNALL Distributing and Power Transformers?

Because AB transformers are consistently a quality product backed by service. They are: safe in insulation; economical to operate; carefully manufactured; rugged and liberal in design. The details as well as the fundamentals are right.

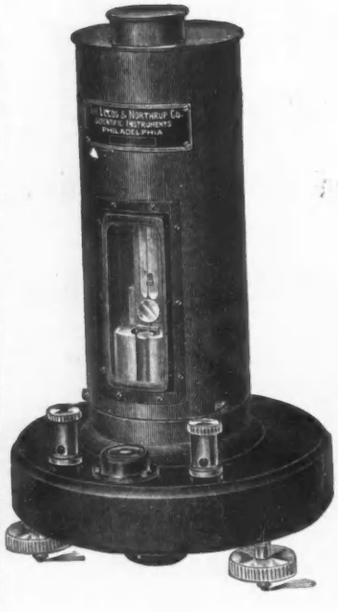
Try them! Have us quote you on your requirements.



22000 Volt, Outdoor Type, Single Phase. A-B Transformer

The Adams-Bagnall Electric Co., Cleveland, Ohio

Manufacturers of Electrical Apparatus of Merit: { Industrial, Commercial and Street Lighting Equipment. Lighting, Power and Constant Current Transformers. Gyrofans; Oscillating Fans; Auto Electrical Accessories.



THE TYPE R GALVANOMETER

HIGH IN SENSITIVITY—MODERATE IN PRICE

This instrument is supplied in two types, as follows:

Type a —Resistance 10 ohms; sensitivity 2 mm. per microvolt with external critical damping resistance (50 ohms) in series; period 6 seconds.

Type b—Resistance 550 ohms; sensitivity 2000 megohms (5×10^{-10} amperes); period 6 seconds.

Note the following brief specifications:

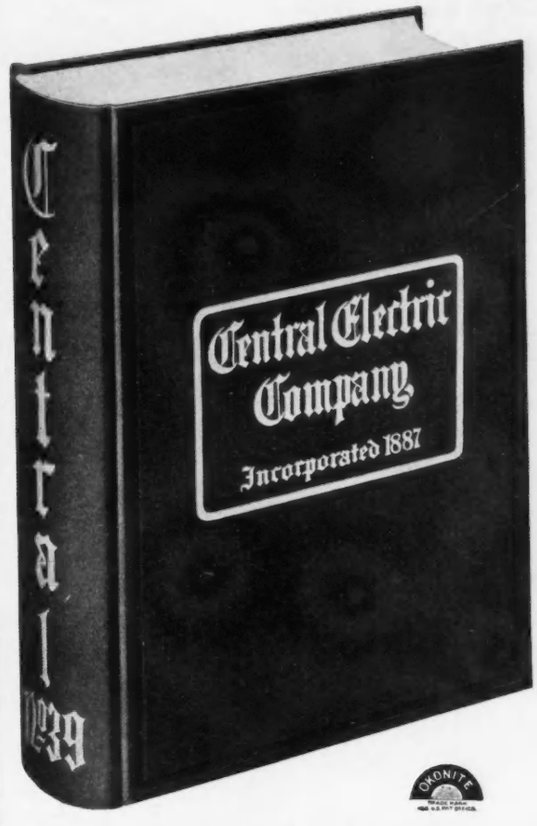
Removable System—The entire system is easily removable to facilitate the replacing of suspensions. *Coil*—This is wound of specially selected wire, as free as possible from magnetic impurities. *Magnet*—Made of special steel, with pole pieces so shaped as to produce a radial field in order to reduce, as far as possible, the effect of foreign magnetic particles in the coil. *Suspensions*—These are of special silver strip rolled in our own factory. *Mirror*—One-half inch in diameter. *Adjustment*—Under the small cap shown on the top of the case of the galvanometer is a knurled head, by means of which the coil may be turned for zero adjustment. *Arrestment*—Under the cap mentioned above is a second knurled head, by means of which the coil may be clamped to prevent damage to its suspensions when the instrument is being moved. *Detail*—The galvanometer is inclosed in a cylindrical metal case finished in black, with a large glass window in front. The instrument is mounted upon an insulating base supported upon three leveling screws. *Setting Up*—As the air gaps are large in comparison to the size of the coil, the instrument is quite easily leveled. To assist in setting up, however, a level is mounted upon the base of the galvanometer.

Bulletin No. 250, describing this instrument, will be sent upon request.

THE LEEDS & NORTHRUP CO.

ELECTRICAL MEASURING INSTRUMENTS

4903 STENTON AVENUE PHILADELPHIA



Different from all others

The New Central Electric Catalog No. 39

has distinctive features which can best be appreciated when seen.

Have you got yours?

If not, write for it on your letterhead. The big book describes everything you use and then some.

Central Electric Company
The House of Service
Chicago, Ill.

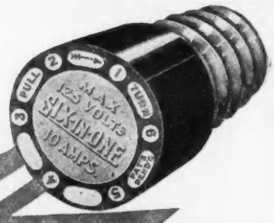
The telephone user may be a hindrance or a help to good telephone service.
When you speak distinctly with the mouthpiece of the transmitter close to the lips, the person you are talking to will have no trouble in hearing and you are co-operating for good service.

American Telephone and Telegraph Company and Associated Companies

AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES — LOCAL AND LONG DISTANCE TELEPHONE — BELL SYSTEM

Send for Sample

You will be greatly interested when you come to examine this wonderful **SIX-IN-ONE** Fuse Plug—it is a marvel of perfect mechanical construction. In order that you may know all about this new Fuse Plug, a sample will be mailed you on request.



Advertised Everywhere

A great many thousands of dollars are being expended to bring the attention of home owners, central stations, isolated plants, etc., to this newest and most economical Fuse Plug.

Every dealer should have this **SIX-IN-ONE** Fuse Plug in stock without delay. It is a big self seller when displayed prominently in your store, and you will find it a good profit maker.

A Big Seller

We supply gratis striking display advertising and circulars in full color—by far the most attractive ever shown in this field.

Atlas Selling Agency, Inc.
450 Fourth Avenue New York

The Expansion and Contraction Strains of Heating and Cooling

Accompanying the heavy, but intermittent loads of conveyors, cranes, hoists, rolling mills, etc., may effect disastrous damage to resistance grids of the many-jointed, cast-iron variety.

But heating and cooling

Type of EMB Resistance Supplied to National Tube Co.

Can't Hurt

EMB

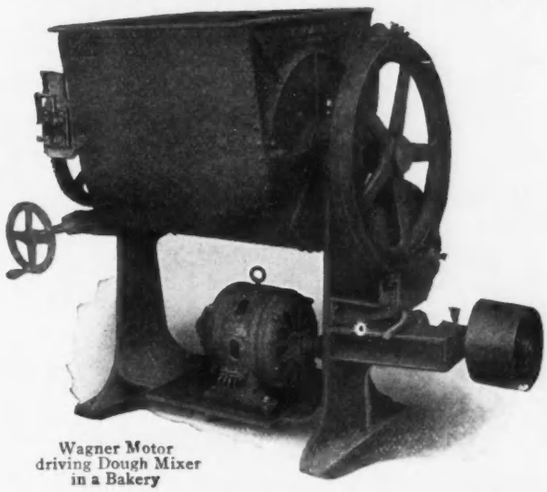
Resistances

They're practically *100% jointless*. Get data.

The Ellcon Co.
50 Church St., New York
GREAT BRITAIN:
Electro-Mechanical Brake Co., Ltd.
West Bromwich, England
AUSTRALIA:
J. G. Lodge & Co., 109 Pitt St., Sydney

What is *Quality* in a Motor?

It is the best of design, materials and workmanship and plenty of each. And to get dependable motors you must have this same quality.



Wagner Motor driving Dough Mixer in a Bakery

Are you willing to save a small sum in the purchase price and pay it out many times over in repairs and delays?

Here is the biggest factor in buying motors. What will it cost to run this

Wagner Quality

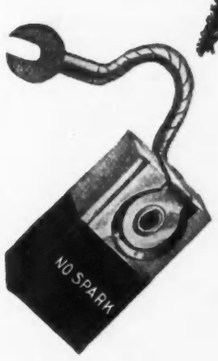
motor one, five or ten years from now?

Send for Bulletins 1104 and 1114.

Wagner Electric Manufacturing Company
Saint Louis, Missouri

376

No-Spark Carbon Brushes #9



The Lubrication Lasts

Dear Jim—

You know the G.M. told me to get NO-SPARK brushes for all our machines after he'd seen the nifty commutation we get from #2 since equipping her with NO-SPARK brushes.

So I ordered three more sets for our other machines.

They arrived O.K. today and I began stripping the old brushes off #1 today, and say, you ought to have seen the commutator. High mica, commutator in grooves and ridges, pitted and fused spots, windings full of copper dust, and—Ch well, you know what happens to a commutator when the brushes are N.G.

Of course I had to turn the commutator down. But I reflected, with satisfaction, that it was the last time I'd have to do it. Once I get the NO-SPARK brushes on there'll be an end to that—#2 proves it.

Why don't you cut out commutation trouble on your machines? Use the COUPON.

Bill

P. S. Don't forget to mail the coupon.

Calebaugh Self-Lubricating Carbon Company Inc.
1503 COLUMBIA AVE. PHILADELPHIA PA.
Please send us data about your NO-SPARK Carbon Brushes and full information regarding your 30 day Free Trial Order.

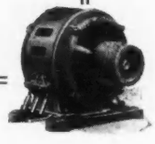
Name .....
Company .....
Address .....

MOTORS FOR EVERY SERVICE REQUIREMENT

In practically every industry where power is used Allis-Chalmers motors are to-day in successful operation. These motors have been applied to almost every well-known make of machine.

Our experience as a pioneer in the application of motors for individual drive and that gained during a quarter of a century devoted to the design, building and commercial application of motors of all kinds will be of inestimable assistance in the selection of motors adapted to your particular service requirements.

ALLIS-CHALMERS MANUFACTURING COMPANY
MILWAUKEE - - - - - - WISCONSIN



AMERICAN BRIDGE COMPANY
HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS

Transmission Tower at Birmingham, Alabama, Alabama Power Company

SALES OFFICES

NEW YORK, N. Y., 30 Church Street
Philadelphia, Pa., . Widener Building
Boston, Mass. . .John Hancock Bldg.
Baltimore, Md., Continental Trust Bldg.
PITTSBURGH, PA. . . Frick Building
Rochester, N. Y. . . . Powers Block
Buffalo, N. Y. . Marine National Bank
Cincinnati, Ohio. Union Trust Building
Atlanta, Ga. . . . Candler Building
Cleveland, Ohio . Rockefeller Building
Detroit, Mich., Beecher Ave. & M. C. R. R.
CHICAGO, ILL., 208 South La Salle St.
St. Louis, Mo., Third Nat'l Bank Bldg.
Denver, Colo., First Nat'l Bank Building
Salt Lake City, Utah, Walker Bank Bldg.
Duluth, Minn. . . . . Wolvin Building
Minneapolis, Minn., 7th Ave. & 2nd St., S. E.

Pacific Coast Representative:
U. S. Steel Products Co. Pacific Coast Dept.
SAN FRANCISCO, CAL., Rialto Building
Portland. Ore. . . . . Selling Building
Seattle, Wash., 4th Ave. So. Cor. Conn. St.

Export Representative:
United States Steel Products Co., 30 Church St., N. Y.

It is more economical—this VUL-COT Fibre.

It is longer wearing.

It is easier to machine into any shape in which you may be using hard rubber, mica, wood or porcelain.

VUL-COT Fibre gears and pinions are noiseless.

VUL-COT Fibre gaskets are oil and grease proof.

It is an exceptional electrical insulator, and is used to the extent of millions of pounds annually for this purpose alone.

We strongly recommend a thorough investigation of this 40-year-old high-quality vulcanized fibre. Its use in your products will prove its economy as it has with thousands and thousands of other manufacturers.

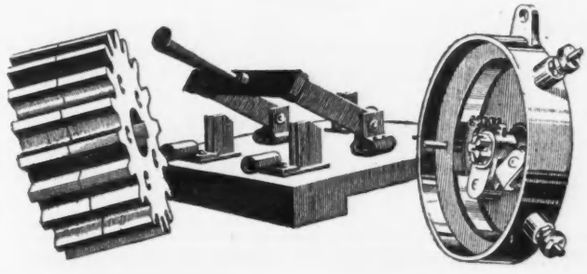
VUL-COT Fibre is easy to buy in almost any form—in sheets, rods, tubes or bars; or ready-machined to your specifications or those we have on file—which have become standardized in many industries.

American Vulcanized Fibre Co.
Largest Manufacturers of Vulcanized Fibre in the World.
535-555 Equitable Building, Wilmington, Del.

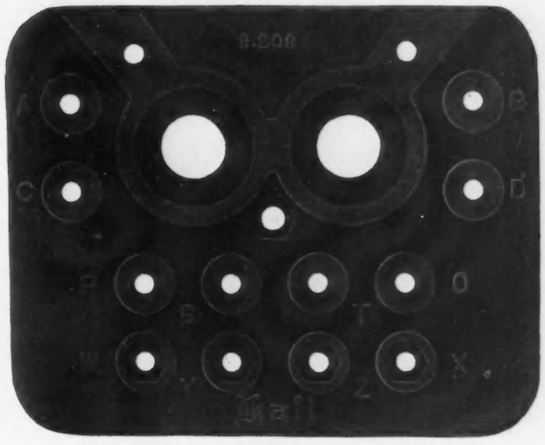
Branches—St. Louis, Boston, New York, Philadelphia, Cleveland, Detroit
Complete stock for immediate shipment at Chicago

Canadian Agents—Northern Electric Company LIMITED
Montreal, Ottawa, Halifax, Toronto, Winnipeg, Calgary, Regina, Vancouver

Vul-Cot Fibre



Instead of Cast Iron or Pressed Metal



Have the covers for electrical instruments molded in **Condensite** and, in addition to a saving in weight, you will secure permanence of brilliant finish, high insulation from internal grounding or short-circuit, and refinement of design and appearance.

The surface of the **Condensite** cover will not wear off nor become rusty or brassy in appearance, for **Condensite** is strictly homogeneous throughout, neither will it "bloom" or otherwise break down in service. Such deterioration is bound to happen in time if the cover is enameled metal or molded in hard rubber.

The **Condensite** cover has sufficient mechanical strength to withstand any ordinary usage to which a first-class instrument is liable to be subjected.

The **Condensite** cover is unaffected by the action of oil or ordinary commercial acids or ordinary solvents, other than alkaline, with which it may be splashed.

Other similar work in thin and deep-walled shapes may be molded in **Condensite** at a considerable saving in expense and time for production, provided the piece is produced in sufficient quantity to distribute the initial cost of the molds. This is particularly true if metallic inserts or complicated shapes are involved, for the **Condensite** piece comes finished from the mold and subsequent machining operations are eliminated.

Condensite molding insures the same accuracy of fit as die-casting—all parts made in the same mold are standard and interchangeable.

What parts are you now making by some other process which may be susceptible to molding in **Condensite?** Re-designing may be unnecessary or relatively simple.

Send us blue prints or sketches and we will tell you if **Condensite** molding will fit in with your production schedule. As we do no custom molding ourselves we will then refer you to a representative list of **Condensite** molders who will gladly quote from your specifications.

Condensite Company of America
Makers of phenolic molding preparations, technical cements and varnishes
Bloomfield, N. J.

Dear Boss:

You know, some of us differ as to dates for New Year's Day. The old Persians said that Sept. 21 was it—June 21 was the ancient Greeks' day—the imperial Romans argued for Dec. 21—medieval Christians for March 25—even today the Russians and Greeks observe January 13th.

But what's the odds?

All that it marks is a day of winding up for another spin—and doing it in the light of the things you've learned from Old Man Experience.

So we're off, Boss, with a flying start, for another year of Nichrome accomplishment, young Nineteen Seventeen and old

Nyc Chrome

DRIVER-HARRIS WIRE CO.
CHICAGO 28 So JEFFERSON ST HARRISON, N.J. MANCHESTER ENGLAND

It adheres to metals under water

Its purpose is the dependable lubrication of under water turbine gate mechanisms. TURBOGLIO was developed for this especially. It remains stable even in the presence of strongly acidulous or alkaline waters. It protects gate mechanisms against corrosion. It makes them sensitive to control.

Turboglio

CREW LEVICK

Hydroglio

It makes WATER the chief part of governor fluid

Two per cent HYDROGLIO and 98 per cent water form the oily emulsion that acts in turbine governor systems with the same dependability and nicety as the most expensive governor oils.

But the difference in cost between this small quantity of HYDROGLIO and the large quantity of high-grade governor oils—otherwise necessary—is obvious.

We will gladly send hydro-electrical engineers interesting printed matter on TURBOGLIO and HYDROGLIO, recounting the exceptional success of these products in the plant of one of the largest hydro-electric companies in the country.

Crew Levick Company
2215-31 Land Title Building
Philadelphia

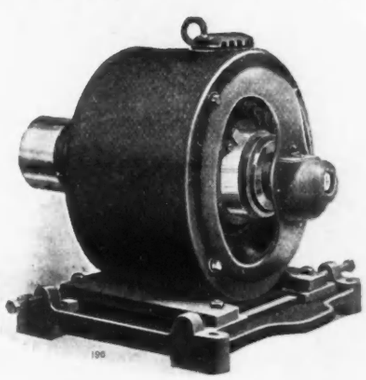
Engraven in the Stone

The tablets of the Pharaohs are decipherable today, because they were made to last. The same spirit of progress and fertile minds that conceived and built the pyramids, looked forward to a day thousands of years in advance when strange races of people would eagerly scan their writings.

Purchasers buying Diehl Motors today are imbued with a similar foresight to that of the ancient Egyptians. They are looking forward to years of service from Diehl Apparatus because Diehl Motors are built from the best of materials and designed and assembled from the viewpoint of

Service to the User

Send for bulletins No. 106, 107, 601



Diehl Manufacturing Co.

Elizabeth, N. J.

New York, Chicago, Boston, Phila., Washington, D. C., Detroit, Denver, Cleveland, San Francisco.

Chooree

In Bombay you leave word for Tom to shave you at 8.00 a. m., but you don't have to get up to keep the appointment.

He comes to your room and without the formality of waking you up he wields his trusty and rusty Chooree through the scrape.

You would be surprised to see how many people can sleep right through this tonsorial stunt without knowing what is happening. WE are not surprised because we see so many operators who are able to sleep through the night watch with the brushes on a rotary scraping and chattering like an election night din.

But the boss wakes up when he reviews the brush bills and the commutator repair bills.

We hope the boss reads this during such a waking moment, and that he will pave the way for a real eye-opener in carbon-brush economy by requesting a Morgan brush engineer to prescribe a type of Morganite that will make no more noise than a motion-picture drama on the screen.

Wake-up!

The Morgan Crucible Company Limited
116 Liberty St, New York City

Factory, Brooklyn, N. Y.

AGENTS:

Lewis & Roth Co., 1012 Liberty Bldg., Philadelphia
Electrical Engineering & Mfg. Co.
First National Bank Bldg., Pittsburgh
W. L. Rose Equipment Co.
La Salle Bldg., St. Louis, Mo.
Herzog Electric & Engineering Co.
150 Steuart Street, San Francisco, Cal.

FIELD COILS SOLENOIDS ELECTRO MAGNETS MAGNET WIRE

THE ACME
WIRE COMPANY

NEW HAVEN
CONNECTICUT

MAGNET WIRE!

Beldenamel
TRADE MARK

THE "STANDARD" FOR ENAMELED WIRE

MADE IN SIZES AS SMALL AS .0015

Our Insulation possesses a remarkable combination of GLASSY HARDNESS AND ELASTIC TOUGHNESS.

Will withstand most Severe TESTS.

BELDEN MANUFACTURING COMPANY
2301 S. Western Ave.
CHICAGO

Sprague Conduit Products

For Every Requirement

Steel Armored Cable and Cord
Flexible and Rigid Conduits
Steel Boxes and Covers
Fittings and Tools

Write for our new Conduit Bulletin No. J-3

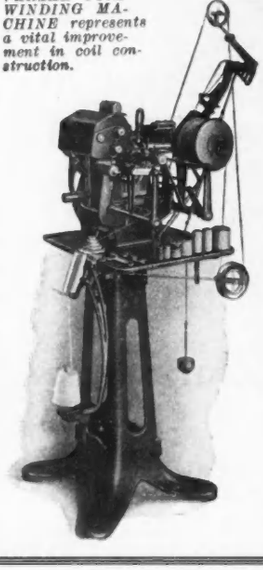
SPRAGUE ELECTRIC WORKS
OF GENERAL ELECTRIC COMPANY
Main Offices:
527-531 West 34th Street, New York, N. Y.
Branch Offices in Principal Cities

The Universal Winding System

To Coil Makers and Users

THE LEESON-UNIVERSAL COIL, automatically wound by the LEESON-UNIVERSAL COIL WINDING MACHINE represents a vital improvement in coil construction.

LEESON UNIVERSAL COIL
Note cross windings of cotton



In this coil fine cotton yarn is CROSS WOUND simultaneously with the concentric winding of the wire.

The finished coil cannot be destroyed by external or internal stress. It has greater symmetry, strength, compactness and durability than a coil wound by any other process. When wound without a core it can be compressed into any shape without losing efficiency.

By carrying the yarn axially to a greater distance than the wire convolutions, the Leeson Machine secures electrical and mechanical protection at both ends of the coil.

Interposing the yarns between the turns and layers of wire secures larger spacing. This permits thorough impregnation.

Automatically winds a predetermined number of convolutions. Coils can be duplicated to the very convolution.

Entire process is automatic. Every type of coil can be wound on this machine, in rectangular or cylindrical forms.

Acquaint yourself fully with Leeson-Universal Winding.

Send for our Catalog. Do it TODAY.

Universal Winding Co.
95 South St. Boston, Mass.

PARAGON
Ground Cones Give You Real Protection

Against lighting and static surges under all conditions. Don't use the ordinary old fashioned plate ground when you can get absolute unvarying protection at a much lower cost with Paragon cones.

One man and a post hole auger is all you need to install them.

Paragon Electric Company

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911 Western Ave., Seattle
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Northern Electric Co., Ltd.
Canadian Distributors.

Control Electric Signs with a Hartford Time Switch

"Wind it once a week—that's all." The approved type of automatic sign control. Users of the Hartford are delighted with it. Reliable, accurate and durable to a high degree. Eliminates the human element. Lights and extinguishes the sign at proper predetermined hours. Ask your jobber's salesman.

HARTFORD TIME SWITCH CO.

A. HALL BERRY, General Sales Agent
97 Warren St., New York, N. Y.
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The Perfect Lighting Control

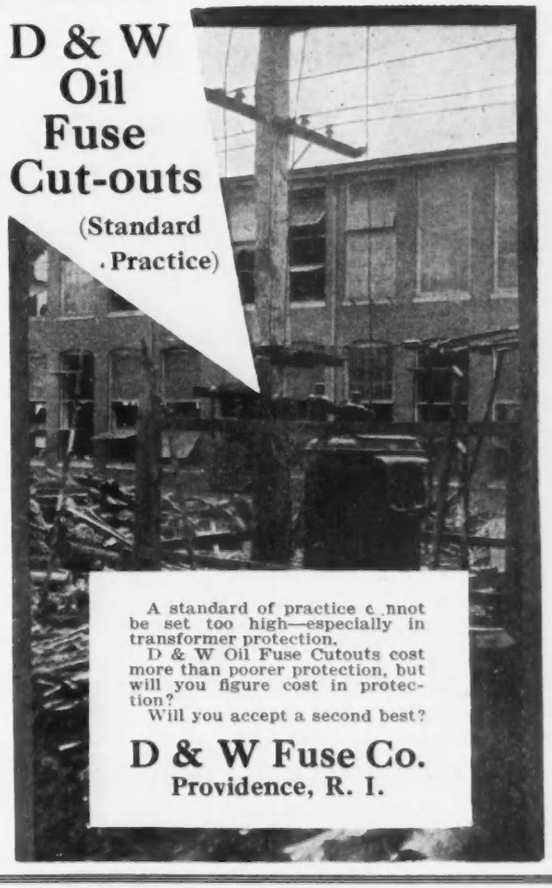
—a time-switch that can be relied on absolutely —that never needs attention beyond a weekly winding—that is as durable as it is dependable. Such a time-switch is the

CAMPBELL
EIGHT DAY TIME-SWITCH

Made in five types covering all light and power control requirements of Central Stations, Jobbers, Dealers and Contractors. A money maker for the dealer who sells it and a money saver for the user. Get acquainted; **write for particulars and confidential prices.**

Campbell Electric Co.
Main Offices and Factory: Lynn, Mass.

D & W Oil Fuse Cut-outs
(Standard Practice)



A standard of practice c nnot be set too high—especially in transformer protection.

D & W Oil Fuse Cutouts cost more than poorer protection, but will you figure cost in protection?

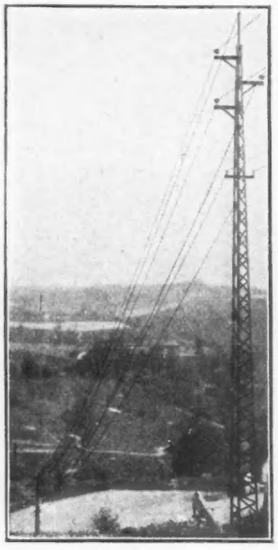
Will you accept a second best?

D & W Fuse Co.
Providence, R. I.

"Make Your Line Construction Permanent"

Franklin Poles and Towers

provide the right kind of economy on transmission lines, cross-over work and dead-ending lines at sub-stations.



The Photograph shows Franklin poles recently installed by the Consolidation Coal Co., Fairmont, W. Va.

Write us for Prices

Franklin Steel Works
Franklin, Pa., U. S. A.

Steel Poles
Bates Steel Pole Lines
Cheaper than wood and will last forever.
276 Bates Steel Poles replacing 828 decayed wood poles in a 16 mile line, a one to three shot; think it over.
No better evidence of the superiority of everlasting steel compared to short lived decaying wood than is fully illustrated in this picture.
Our Steel Pole Treatise tells the story.
Bates Expanded Steel Truss Co.
208 South La Salle Street
Chicago, Ill. U. S. A.

We have constantly on hand about two thousand tons of steel and can make immediate shipment. We make the STRONGEST pole of like weight in the world. They are made of ONE PIECE of steel.

There are NO RIVETS, BOLTS or JOINTS to rust and loosen. They are easily painted and will last forever.

SHERWIN-WILLIAMS

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INSULATING VARNISH
(CLEAR AIR-DRYING)

For armatures, field and magnet-coils, mouldings, switches and fibre-sheet insulation, etc. Especially useful where baking facilities are lacking. It is a high insulator possessing extreme penetrating qualities and dries in six hours to a uniform, elastic, oil-proof, moisture-proof film.

Send for our Insulating Catalog

THE SHERWIN-WILLIAMS CO.
INSULATING MATERIAL MAKERS
700 CANAL ROAD CLEVELAND, OHIO

GURNEY GURNEY GURNEY

Gurney Ball Bearings

do not show measurable wear during many years of continuous service. Because of this absence of wear Gurney equipped motors may be built with a much smaller air gap than is possible in plain bearing motors and their efficiency is correspondingly much greater.

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CONRAD PATENT LICENSEE
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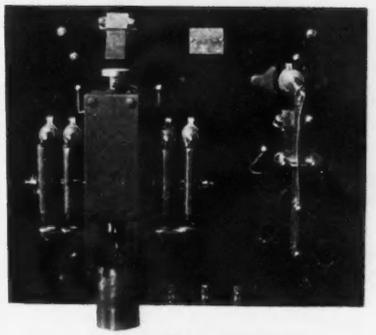
"Specified for Quality"

Alternating and Direct Current

Automatic
Motor Starters and Controllers



DIRECT CURRENT
Jewell Automatic Starter with Main Line Copper Switch
FOR REMOTE CONTROL

- Automatic Motor Starters
- Remote Control Starters
- Elevator Controllers (Freight)
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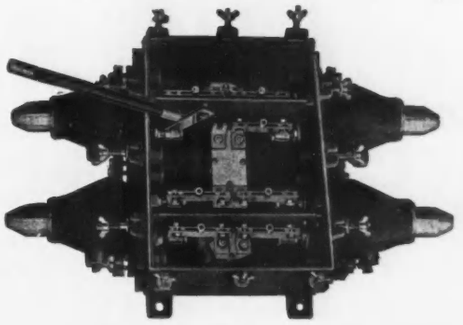
- Pump Controllers
- Printing Press Controllers
- Automatic Speed Regulators
- Automatic Motor Controllers
- Elevator Reversing Switches
- Accessories and Others

The Jewell Electric Co.

EXECUTIVE OFFICES
Munsey Building - - Baltimore, Md.

4

G & W
PRIMARY DISTRIBUTION BOXES



Big capacity in small space yet allows room for plenty of compound. Construction minimizes exposure of live parts. Special design of contact parts insure *positive contact* and *safe operation.*

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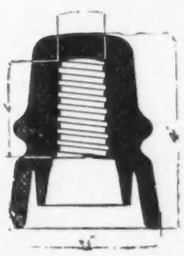

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There is a "Pittsburg" for every kind of service.

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4

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Manufactured for all electrical purposes in any size, frequency, or voltage.

Lighting and Power Transformers
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Single and 3-Phase Transformers

To secure prices give us K. W. capacity voltage, cycles, transformers required.

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Keeping the pace in transformer design

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Seventeen years of specializing on transformer design have carried us through the experimental stage onto the safe ground of sound manufacturing practice. You can rest assured that the Peerless Transformer you buy today—or five years from now—is and will be the last word in thorough practical, dependable and efficient transformer design and construction. (And the price will be right, too.)

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"LOOMFLEX"
Flexible Conduit

Why consider the destructible when you can have the indestructible?

No matter how badly crushed, twisted or kinked, "Loomflex" can always be pinched back into shape and used. Easy to fish—all sizes are slightly oversized and there are no seams to break loose. The roller-bearing construction of the interior allows the wire to slide through with a minimum of friction.

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American Circular Loom Co.
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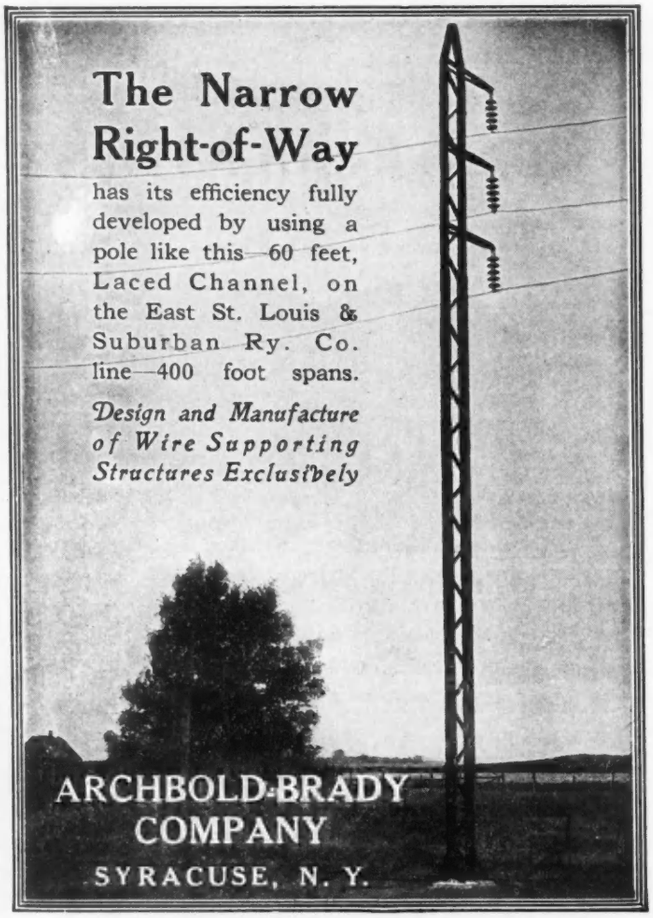
The Narrow Right-of-Way

has its efficiency fully developed by using a pole like this—60 feet, Laced Channel, on the East St. Louis & Suburban Ry. Co. line—400 foot spans.

Design and Manufacture of Wire Supporting Structures Exclusively



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TRADE AUM MARK Renewable Fuses

Always were the simplest fuses in construction on the market. The new Type "B," Form 4, has been reduced to the fewest parts—four metal parts of solid brass, a fibre shell, and the fuse strips. Caps are removed by a twist of the wrist and as easily tightened, holding the fuse strip in intimate metal-to-metal contact.

Free Samples If You Write Today

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Representatives:
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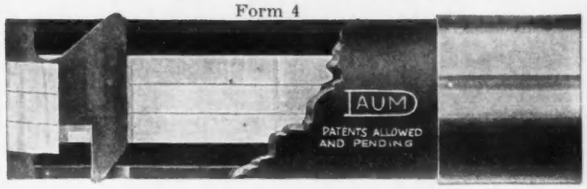
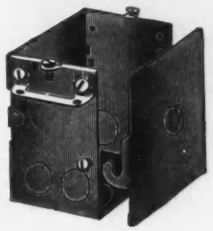
Form 4



TRADE MARK "UNION" SWITCH AND OUTLET BOXES TRADE MARK

The Sectional Switch Box has come to stay, for the contractor knows that its flexibility of construction more than offsets its slightly increased cost.

It is the work of only a few minutes to build a Gang Box from sections, while it may take hours or days to get a solid gang box from the jobber or factory. The sectional box also reduces the jobber's stock and avoids the accumulation of slow moving material.

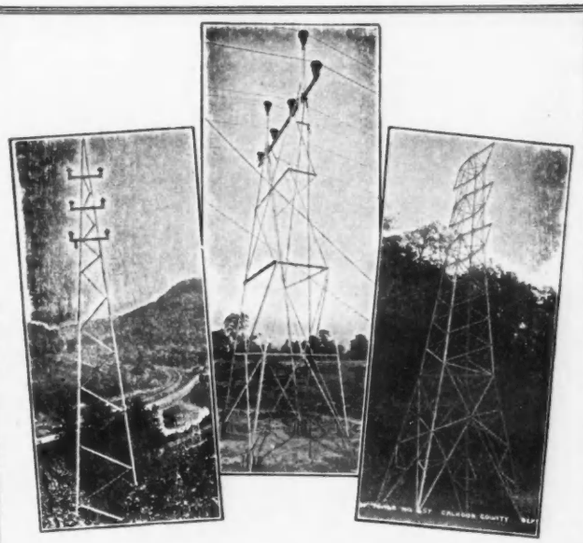


The contractor can find a box for every requirement among the "Union" sectional Switch Boxes—depths from 2″ to 3½″—square or beveled corners—with K. O. for "Loom," Flexible or Rigid conduit.

Fully listed and described in new No. 28 catalog. Write for a copy.

TRADE MARK CHICAGO FUSE MFG. CO. TRADE MARK

CHICAGO NEW YORK



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Manufacturers and Erectors of Galvanized Transmission Towers, Penstocks, Tanks, Gasholders, Blast Furnaces, Steel Buildings and Bridges.

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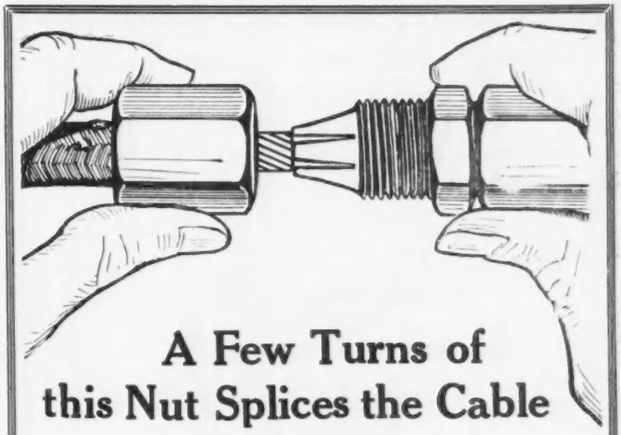
Pittsburgh, Pa.



A Few Turns of this Nut Splices the Cable

That's a lot easier than the sweating and soldering method isn't it. And a lot safer too.

FRANKEL SOLDERLESS CONNECTORS

Patented Feb. 19, 1907; July 30, 1907; May 25, 1909

are easy to install—insure a splice that won't open up on heavy loads—are as easy to open as they are to make up. Made for every need. *Get details.*

Factory:
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Sales Rooms:
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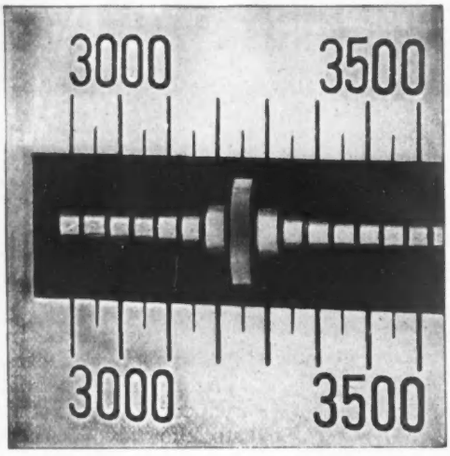

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For indicating speeds of Steam Turbines, Centrifugal Pumps, Centrifuges, Generators, Motors, etc., our

FRAHM VIBRATION TACHOMETER

is *absolutely different* from all other instruments. It sustains initial accuracy indefinitely; and also requires *no belt, gears, or electrical connection.*

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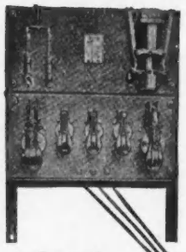
Tank and Sump Switches

Start motor when water is low and stop it when high or vice versa.



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Controls speed of distant motor-operated devices.

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Electrical Control

A.C. D.C.

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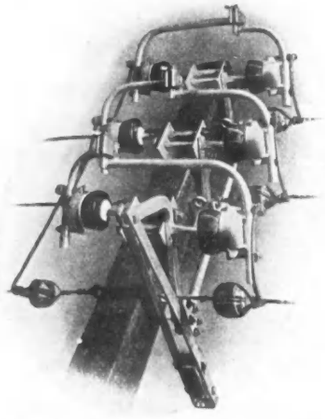
K.P.F. switches are built to last.



Type L-115 K.P.F. 2200-4500 Volt Switch

K.P.F. Electric Company

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Use it as your reference file on measuring instruments.

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Your requirements for Multiple Decorative Miniature lamps will be properly taken care of if you specify Tung-sol.

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Nitrogen Filled Lamp

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Liberal guarantees.
Prompt shipments.
Get our prices.

—of course it's an ARGOLYTE.

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Licensed under General Electric Co. Patents

Lux Argon and Nitrogen Gas Filled Lamps

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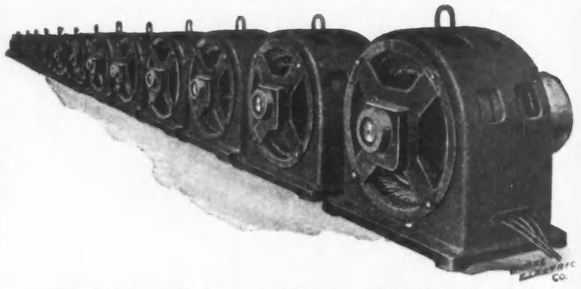

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Motors for all purposes where reliable power is essential.

ALL SIZES ALL SPEEDS ALL VOLTAGES

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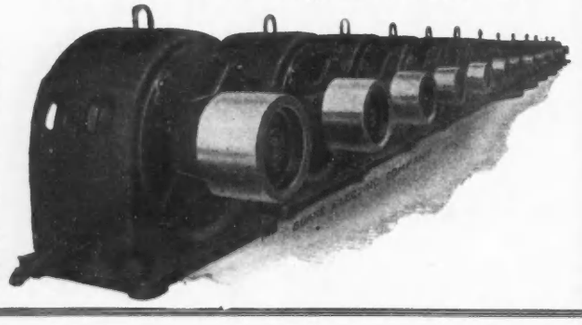

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It is what you see from the outside.

Century

SINGLE PHASE MOTORS

are constructed for service under severe conditions—not as ornaments.

Illustrating a 2 h.p. motor

However, the accurate and careful construction following well considered designs results in a neat, symmetrical motor pleasing in appearance even with the stock finishes usually applied to machinery.

1/10 to 40 H.P.—25 to 140 Cycles.

THEY KEEP-A-RUNNING

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SALES OFFICES IN PRINCIPAL CITIES

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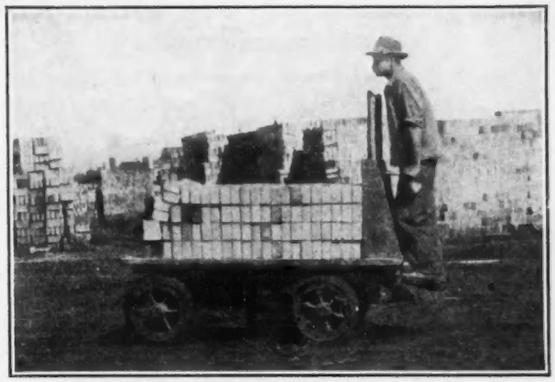

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The rapidly increasing use of storage battery industrial trucks and tractors is bound to mean additional income for Central Stations. Here is an opportunity for Central Stations to help in developing a new and profitable business.

The "Ironclad-Exide" Battery is standard for industrial truck service.

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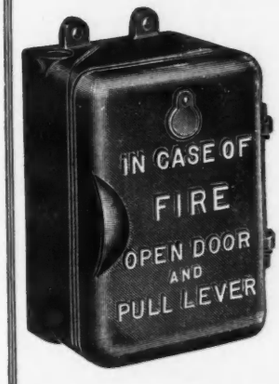

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conform to the requirements of the State Dept. of Labor, New York, and the Fire Prevention Bureau of New York City.

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FLEXIBLE WOVEN CONDUIT

Chemists say — apply first the water-proofing, afterward the fire-proofing compounds.
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Successors to
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Bare Copper Wire and Cable
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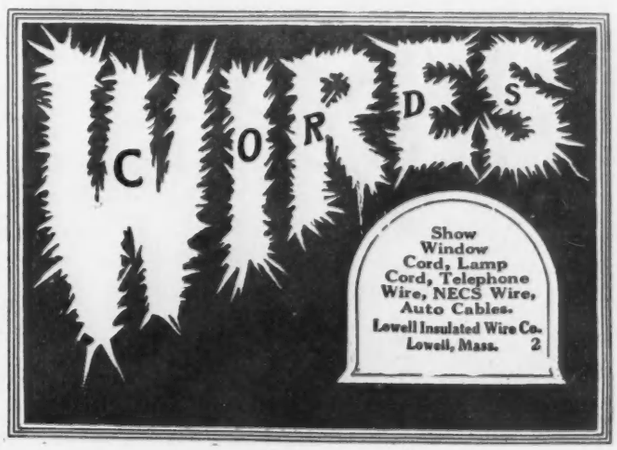

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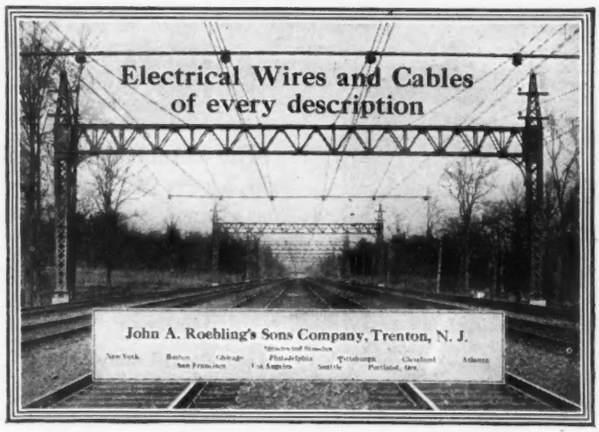

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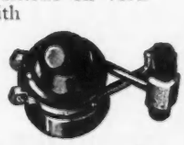

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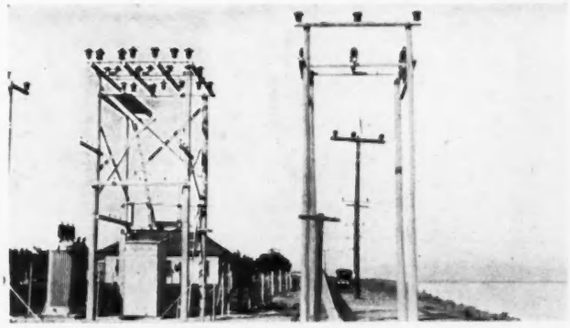

A sectionalizing and substation on the banks of the Columbus River. Wooden pole lines are covered thoroughly in *Electrical World.*

The method of designing and constructing th[is] hillside substation appeared in *Electrical World. World* readers [get] such information first.

THE **Electrical World** publishes everything of value bearing on the design and construction of pole and tower lines, and on electrical transmission in general, besides an enormous fund of data on other electrical developments. During the last year Electrical World has published more than 200 articles for the transmission engineer, covering:

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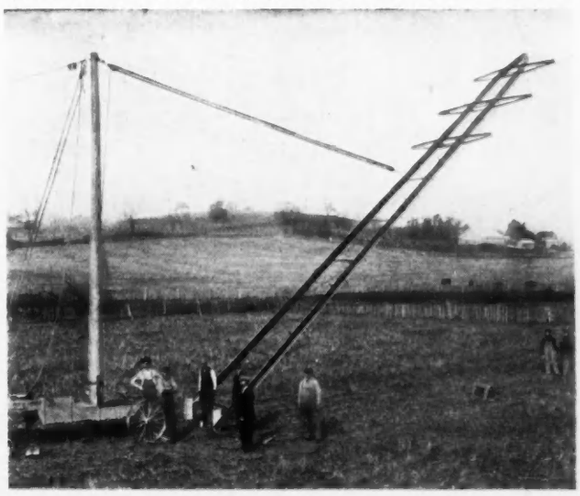
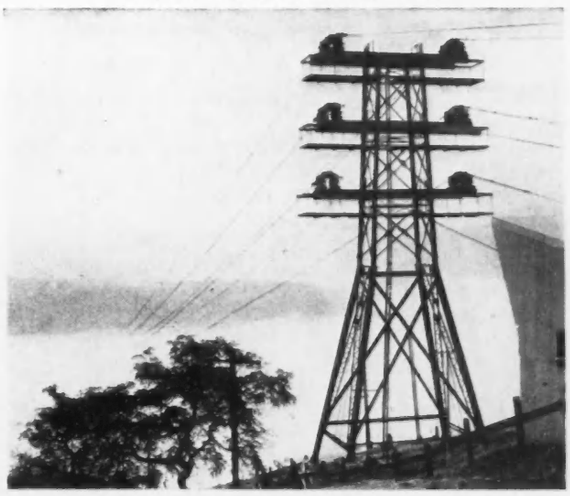
In 1916, over 100 methods of raising and setting pole lines were described. Also methods of changing insulators on live high tension lines.



The construction of this straining tower and the entire system was fully described in the *Electrical World.*



[SEE NEXT PAGE FOR SPECIAL OFFER]

Pole and Tower Lines

For Electric Tower Transmission

[Published January, 1916]

By R. D. COOMBS, C.E., Consulting Engineer, M. Amer. Soc. C.E., etc.

272 pages, 6 x 9, 162 illustrations, 30 tables. $2.50 (10/6) net, postpaid

THE enormous growth in the number of electrical power transmission and distribution lines within the past decade has necessitated the abandonment of the "rule of thumb" methods used in transmission line design and construction. Today, structural details and non-electrical problems are determined by the civil engineer or expert specializing in such work.

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"Pole and Tower Lines" is an exceptionally valuable reference book and should be in the library of every transmission engineer.

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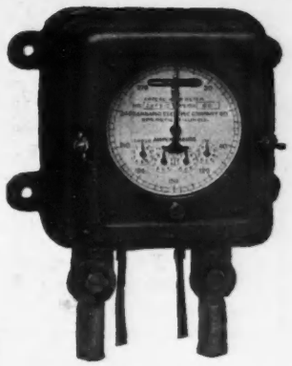

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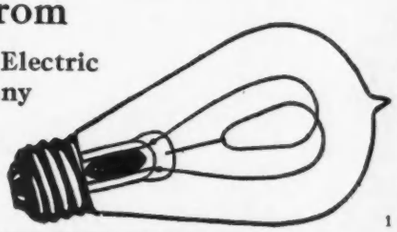

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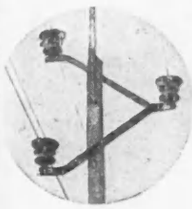

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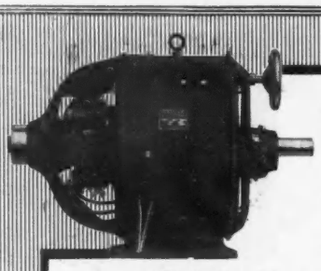

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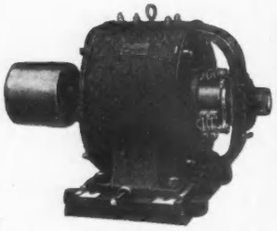

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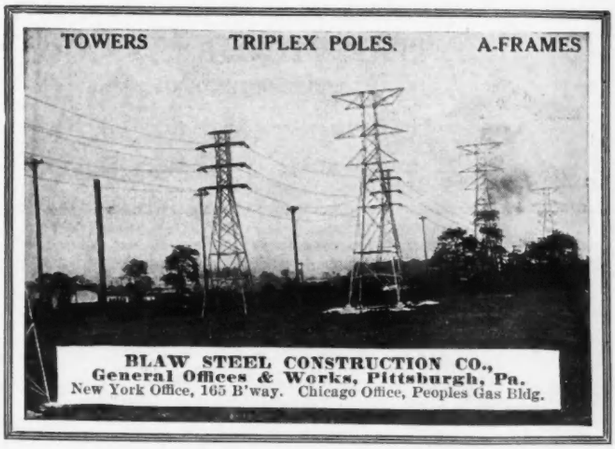

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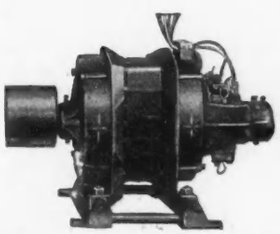

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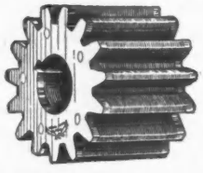

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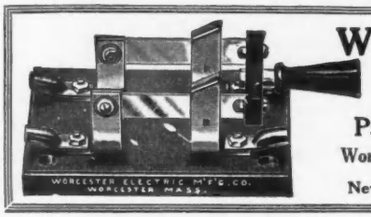

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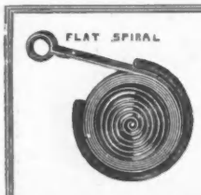

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STAPLES best for wiring.
TUBE FLUX best Flux for soldering.
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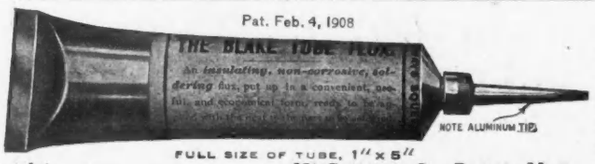

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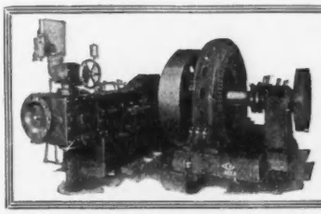

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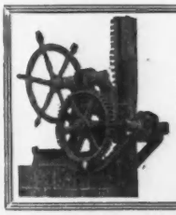

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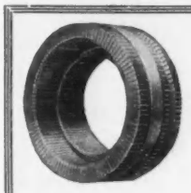

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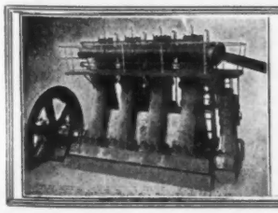

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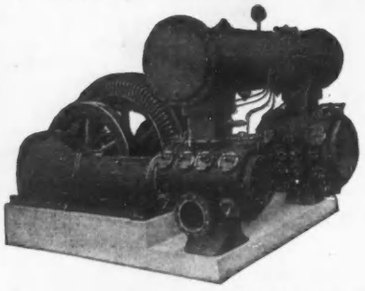

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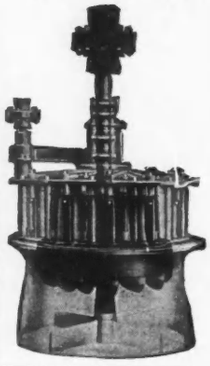

SAMSON TURBINES tested in the HOLYOKE Testing Flume show an efficiency over 93% (see Test No. 2363).

Use a SAMSON to drive your generator and you will save money.

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THE STANDARD FOR
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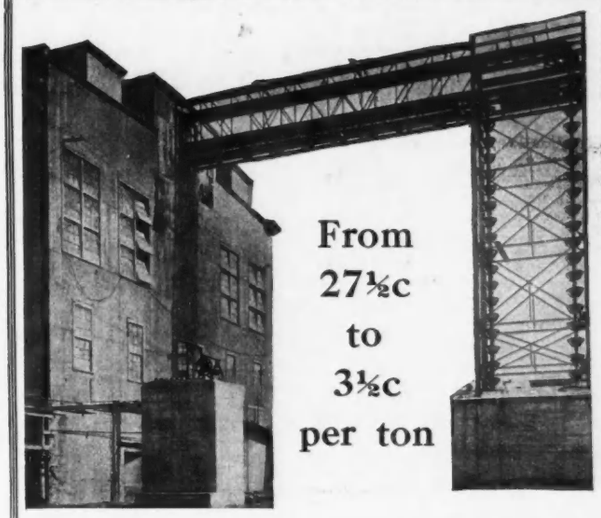

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The station was located 800 feet from the wharf front, and paid 27½c. per ton on a yearly consumption of 25,000 tons per year to move the coal to the front of their boilers.

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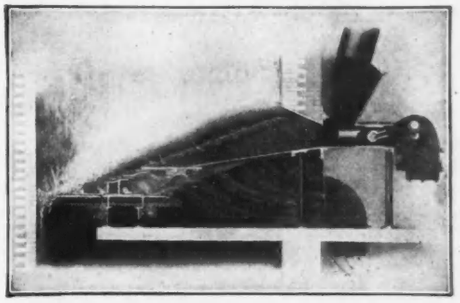
The Stoker with the Reciprocating Retort Sides



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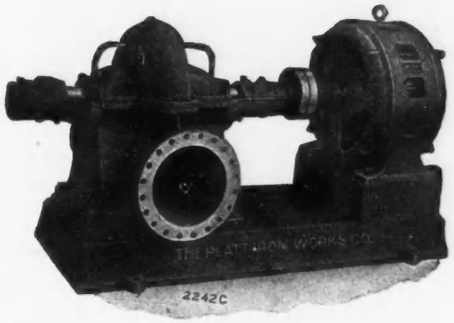
PLATT IRON WORKS - DAYTON, OHIO.
PLATT

Platt Double Suction Centrifugal Pumps



Split case features insure accessibility. Their rugged construction guarantees efficient and continuous service whether installed where every facility is at hand, or in the most isolated parts of the world.

Bulletin No. 762 fully describes them.

Standard Pumps for Every Service

PLATT IRON WORKS, DAYTON, OHIO
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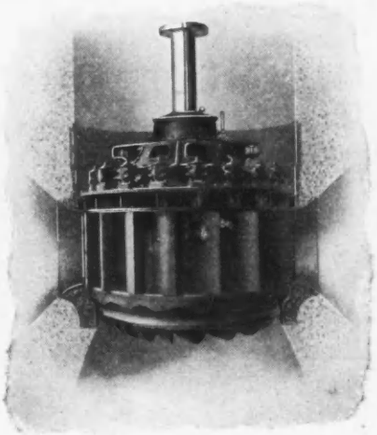
HYDRAULIC TURBINES



Five Vertical Direct-Connected Units
In Concrete Spiral Flumes
BUILT FOR
The Wateree Power Co., Charlotte, N. C.
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55 Ft. Head—11000 H. P. Each—97.3 R. P. M.

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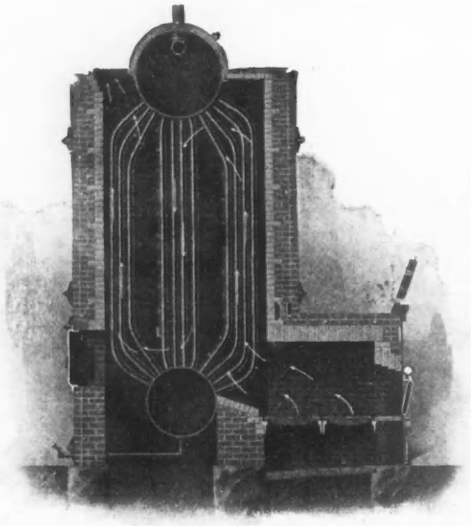
SAN FRANCISCO, 505 Sheldon Building

Get the Boiler that is easy to clean—
no leaky hand holes to pack



The rapid circulation and almost vertical placing of tubes in Erie City Vertical Water Tube Boilers render the deposit of scale almost negligible in these boilers. Therefore *cleaning* of the interior of tubes in

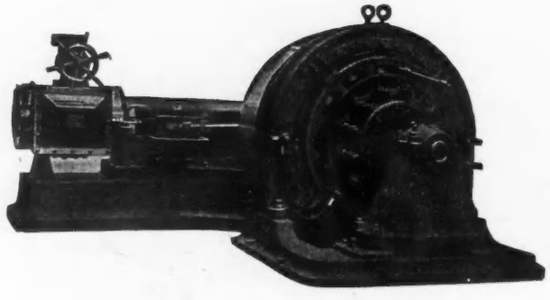
ERIE CITY VERTICAL WATER TUBE BOILERS

is necessary much less often than is usual with many boilers. Yet when it is required ready access to the tubes can be had from the drum interior through conveniently located manholes. The vertical position of the tubes greatly facilitates removal of scale which can be easily withdrawn from the drum. And there are *no leaky hand holes* to open and close and worry about. These are features to *remember*. Write for more data.

Erie City Iron Works, Erie, Pa.

3

What's your idea of generator merit?— is it EFFICIENCY?



In these days of extraordinary efficiencies developed by enormous turbo-generators, one does not expect anything startling in the way of efficiency from small units.

Nevertheless, we can show you a thing or two from RIDGWAY UNIT service records that will **interest** you—if you're out to be shown an efficient unit for small Central Station or isolated plant service. Facts and figures for the asking.

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Ridgway Dynamo & Engine Co., Ridgway, Penna.

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Beardslee Chandelier Mfg. Co.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.
Hinsdill Elec. Co.
Kandem Elec. Co., Inc.

Flashers.
Campbell Electric Co.

What Advertisers Offer to Readers

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Fuse Boxes.
(See Boxes, Fuse.)

Fuses.
Atlas Selling Agency, Inc.
Chicago Fuse Mfg. Co.
Condit Electrical Mfg. Co.
D & W Fuse Co.
Daum, A. F.
Economy Fuse & Mfg. Co.
Electric Fuseguard Co.
General Electric Co.
Kandem Elec. Co., Inc.
Metropolitan Eng'g Co.
Multi-Refillable Fuse Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Western Electric Co.

Fuses, Refillable.
Daum, A. F.
Economy Fuse & Mfg. Co.
Electric Fuseguard Co.
Multi-Refillable Fuse Co.

Gages, Recording.
Bristol Co.
Foxboro Co., The.

Gages, Water Column.
Jenkins Bros.

Gas Holders.
Riter-Conley Co.

Gas Meters, Electric.
Cutler-Hammer Mfg. Co.

Gears.
New Process Gear Corp.

Gear Shift, Electric.
Cutler-Hammer Mfg. Co.
Jewell Elec. Co.

Generating Sets, Engine & Turbine.
Sturtevant Co., B. F.

Globes, Shades, Etc.
Adams-Bagnall Electric Co.
Faries Mfg. Co.

Grounds, Etc.
Paragon Elec. Co.

Guards, Incandescent Lamp.
Hubbell, Inc., Harvey.
Matthews & Bro., Inc., W. N.

Hair Dryers.
Shelton Elec. Co.

Hangers, Cable.
Condit Electrical Mfg. Co.
Hubbard & Co.

Head Gates.
American Bridge Co.

Head Gate Hoists.
Dayton Globe Iron Works.

Heaters, Feed Water.
National Pipe Bending Co.
Platt Iron Works.

Heating Devices, Electric.
Cutler-Hammer Mfg. Co.
General Electric Co.
Kandem Elec. Co., Inc.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Heating, Steam.
American District Steam Co.

Heating & Ventilating Systems.
Sturtevant Co., B. F.

Hoists, Electrical and Steam.
Allis-Chalmers Mfg. Co.
Maris Bros.
Sprague Electric Works.

Hydraulic Machinery.
Platt Iron Works.

Igniters, Gas Engine.
Carlisle & Finch Co.

Indicators, Sight Flow.
Richardson-Phenix Co.

Indicators, Speed.
Biddle, James G.
Roller-Smith Co.

Industrial Railways.
Hunt Co., Inc., C. W.

Injectors.
Jenkins Bros.

Instrument Transformers.
Weston Electrical Instr. Co.

Instruments, Electrical.
Graphic.
Biddle James G.
Bristol Co.
Esterline Co.
General Electric Co.
Keystone Electrical Inst. Co.
Mineralac Electric Co.
Sangamo Elec. Co.
Westinghouse Elec. & Mfg. Co.
Indicating.
General Elec. Co.
Keystone Electrical Inst. Co.
Pignolet, L. M.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Inst. Co.
Integrating.
Biddle, James G.
Duncan Electric Mfg. Co.
General Electric Co.
Roller-Smith Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Scientific and Testing.
Biddle, James G.
Esterline Co.
General Electric Co.
Keystone Electrical Inst. Co.
Leeds & Northrup Co.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.
Roller-Smith Co.

Insulating Machinery.
American Ins. Machinery Co.
New England Butt Co.

Insulating Material.
China and Porcelain.
Colonial Sign & Ins. Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Parker & Son, J. H.
Pittsburg H. V. Ins. Co.
Thomas & Sons Co., R.
Compounds, Paints and Varnishes.
Condensite Co. of America.
Diamond State Fibre Co.
Dickinson Mfg. Co.
General Electric Co.
Hemming Mfg. Co.
Irvington Varnish & Ins. Co.
Mineralac Electric Co.
Packard Elec. Co.
Pomona Rubber Co.
Sherwin-Williams Co.
Sterling Varnish Co.
Composition Cloth and Paper.
Diamond State Fibre Co.
Irvington Varnish & Ins. Co.
Mitchell-Rand Mfg. Co.
Fibre.
Amer. Vulcanized Fibre Co.
Continental Fibre Co.
Diamond State Fibre Co.
Lava.
Steward Mfg. Co., D. M.
Mica.
Munsell & Co., Eugene.
Silk.
Irvington Varnish & Ins. Co.
Ryle & Co., Wm.
Tape.
Diamond State Fibre Co.
Mitchell-Rand Mfg. Co.
Packard Elec. Co.
Standard Woven Fabric Co.

Insulating Paper.
Diamond State Fibre Co.
Irvington Varnish & Ins. Co.

Insulators.
China, Porcelain and Composition.
Colonial Sign & Ins. Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Pittsburg High Volt. Ins. Co.
Thomas & Sons Co., R.
Glass.
Brookfield Glass Co.
Hemingray Glass Co.
Locke Insulator Mfg. Co.

Insulator Pins.
Hubbard & Co.
Thomas & Sons Co., R.

Lamps, Arc.
Adams-Bagnall Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Flaming Arc.
General Electric Co.
Kandem Elec. Co., Inc.
Westinghouse Elec. & Mfg. Co.

Lamps, Incandescent.
Boston Economy Lamp Div.
Consolidated Elec. Lamp Co.
Duhrssen & Pfaltz, Inc.
General Electric Co.
Hygrade Lamp Co.
Independent Lamp & Wire Co.
Lux Mfg. Co.
National Lamp Works.
Western Elec. Co.
Whitelite Elec. Co.

Lamps, Miniature.
General Electric Co.

Lamps, Portable.
Faries Mfg. Co.

Lamp, Replacers.
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Delta Star Elec. Co.
General Electric Co.
Hubbard & Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Line Material.
Anderson Mfg. Co., A. & J. M.
Archbold-Brady Co.
G & W Elec. Specialty Co.
General Electric Co.
Hubbard & Co.
Matthews & Bro., Inc., W. N.
Ohio Brass Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

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Linemen's Shields.
Matthews & Bro., Inc., W. N.

Lubricant, Hydraulic Governor.
Crew Levick Co.

Lubricant Hydraulic Turbine.
Crew Levick Co.

Lubrication Engineers.
Richardson-Phenix Co.

Lubricating Oils.
Texas Co.

Lubricators.
Richardson-Phenix Co.

Machines, Armature Notching.
Ferracute Machine Co.

Machines, Calculating.
Marchant Calculating Mach. Co.

Magnet Wire.
Acme Wire Co.
American Brass Co.
American Electrical Works.
American Steel & Wire Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
D & W Fuse Co.
General Electric Co.
Independent Lamp & Wire Co.
Massachusetts Elec. Mfg. Co.
Roebling's Sons Co., J. A.
Rome Wire Co.
Western Elec. Co.

Magnets.
Acme Wire Co.

Magnets, Lifting.
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.

Magnets, Permanent.
Esterline Co.

Mechanical Draft.
Sturtevant Co., B. F.

Mechanical Stokers.
American Engineering Co.
Riley Stoker Co., Ltd., Sanford.

Medical Apparatus.
Manhattan Electrical Supply Co.
Pignolet, L. M.

Meter Testers.
States Company.

Meters, Flow.
Spray Engineering Co.

Meters, Water.
Builders Iron Foundry.

Mica.
Munsell & Co., Eugene.

Mining Machinery.
Allis-Chalmers Mfg. Co.
Crocker-Wheeler Co.

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Belden Mfg. Co.
Cutler-Hammer Mfg. Co.
Dickinson Mfg. Co.
Hemming Mfg. Co.

Molybdenum Wire.
Commercial Research Co.

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Klein & Sons, Mathias.

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Carlisle & Finch Co.

Nozzles, Spray.
Spray Engineering Co.

Oiling Systems, Cutting.
Richardson-Phenix Co.

Oiling Systems, Hydroelectric.
Richardson-Phenix Co.

Oiling Systems, Sight Feed.
Richardson-Phenix Co.

Oiling Systems, Turbine.
Richardson-Phenix Co.

Oil, Lubricating.
Texas Co.

Oil, Transformer.
Texas Co.

Oils, Cylinder.
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Oilers, Telescopic.
Richardson-Phenix Co.

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Light & Development Co. of St. Louis.

Packing.
Jenkins Bros.

Panel Boards.
Adams-Bagnall Electric Co.
General Electric Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Penstock.
Portland Wood Pipe Co.

Photometric Apparatus.
Electrical Testing Laboratories.
Leeds & Northrup Co.

Pinions, Rawhide.
New Process Gear Corp.

Pipe.
Portland Wood Pipe Co.

Pipe Fittings.
Richardson-Phenix Co.

Pipe (Riveted Steel).
Riter-Conley Co.
Schweitzer & Conrad, Inc.

Platinum.
Baker & Co., Inc.

Plugs.
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Cutler-Hammer Mfg. Co.
Hubbell, Inc., Harvey.

Pole Erectors.
American Bridge Co.
Matthews & Bro., Inc., W. N.

Pole Line Hardware.
Hubbard & Co.
Matthews & Bro., Inc., W. N.
Western Elec. Co.

Poles, Brackets, Pins, Etc.
Central Electric Co.
Western Elec. Co.

Poles, Reinforcing.
Hubbard & Co.

Poles, Steel.
American Bridge Co.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Blaw Steel Cons. Co.
Coombs, R. D.
Franklin Steel Works.
Western Elec. Co.

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Carney & Co., B. J.

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Biddle, James G.
General Electric Co.
Leeds & Northrup Co.

Potheads.
Colonial Sign & Insulator Co.
G & W Elec. Specialty Co.
Okonite Co., The.

Protective Devices.
General Electric Co.
Metropolitan Engineering Co.
Schweitzer & Conrad, Inc.

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Worthington P. & M. Corp.

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Platt Iron Works.

Pumps, Oil.
Platt Iron Works.
Richardson-Phenix Co.
Worthington P. & M. Corp.

Pumps, Steam Driven.
Allis-Chalmers Mfg. Co.
Platt Iron Works.
Worthington P. & M. Corp.

Pumps, Vacuum.
Platt Iron Works.
Worthington P. & M. Corp.

Pumps, Water Works.
Pelton Waterwheel Co.
Platt Iron Works.

Push Buttons.
Manhattan Electrical Supply Co.

Pyrometers.
Bristol Co., The.
Esterline Co.
Keystone Electrical Inst. Co.
Leeds & Northrup Co.

Rail Bonds.
American Steel & Wire Co.
Condit Electrical Mfg. Co.
General Electric Co.

Railways, Miniature.
Carlisle & Finch Co.

Ranges, Elec.
Cutler-Hammer Mfg. Co.
General Electric Co.

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General Electric Co.

Reflectors.
Adams-Bagnall Electric Co.
General Electric Co.

Repairing.
Gregory Electric Co.

Resistance Units.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Elicon Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.

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Biddle, James G.
Campbell Electric Co.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Elec. Co.

Rosettes.
General Electric Co.
Hart Mfg. Co.

Rubber Covered Wire.
Roebling's Sons Co., J. A.

Searchlights.
Carlisle & Finch Co.
Esterline Co.
General Electric Co.

Second-hand Apparatus.
Archer & Baldwin.
Big Four Ice & Cold Storage Co.
Consolidated Rolling Mills & Foundries Co., Inc.
Graham, Jas. A.
Gregory Electric Co.
Holcomb & Co., Inc.
Jordan Bros., Inc.
Klein & Co., Nathan.
Latshaw Machinery Co.
Louisville Gas & Elec. Co.
MacGovern & Co.
Miller Owen Elec. Co.
Nelson, R. I.
Power Machy. Exchange, Inc.
Schwartz & Land.
Standardwood, Taylor & Co.
Von Phul, G. D.
Wall Rope Works, Inc.
Wilson Machinery Co., H. R.
Winter, G. E.

Separators, Magnetic.
Cutler-Hammer Mfg. Co.

Shade Holders.
Adams-Bagnall Electric Co.
General Electric Co.
Hubbell, Inc., Harvey.

Sheet Metal.
Amer. Sheet & Tin Plate Co.

Sheets, Electrical.
Amer. Sheet & Tin Plate Co.

Shovels, Pole Hole.
Matthews & Bros., Inc., W. N.

Signs.
Colonial Sign & Ins. Co.

Signs, Electric.
Colonial Sign & Ins. Co.

Slate.
Portland-Monson Slate Co.

Sleeves, Splicing.
Hatch, E. G.

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Benjamin Elec. Mfg. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
Hubbell, Inc., Harvey.
Kandem Elec. Co., Inc.

Sockets, Turndown.
General Electric Co.

Soldering Flux.
Blake Signal & Mfg. Co.
Condit Electrical Mfg. Co.

Soldering Irons.
General Electric Co.

Soldering Outfits, Acetylene.
Prest-O-Lite Co., Inc.

Solenoids.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.

Special Machinery.
Torrington Mfg. Co.

Speedometers.
Keystone Electrical Inst. Co.

Splicing Sleeves.
Frankel Connector Co., Inc.

Springs.
American Steel & Wire Co.
Cary Spring Works.
Cook Spring Co.

Stacks, Steel Smoke.
American Bridge Co.

Stage Lighting Apparatus.
Campbell Electric Co.
Condit Electrical Mfg. Co.

Staples.
American Steel & Wire Co.
Blake Signal & Mfg. Co.

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Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Sundh Elec. Co.
Ward Leonard Elec. Co.

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Edge Moor Iron Co.
Green Eng'g Co.
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General Electric Co.
Transmission Engr'g Co.

Supplies (Electric Railway).
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General Electric Co.
Ohio Brass Co.
Western Elec. Co.

Supplies, Electrical.
Central Electric Co.
General Electric Co.
Kandem Elec. Co., Inc.
Manhattan Elecl. Supply Co.
Western Elec. Co.

Switchboard Supplies.
Condit Electrical Mfg. Co.
General Electric Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

Switchboards.
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Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
General Electric Co.
Roller-Smith Co.
Triumph Elec. Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Automatic Time.
Anderson Mfg. Co., A. & J. M.

Switches, Disconnecting.
Anderson Mfg. Co., A. & J. M.
Matthews & Bros., Inc., W. N.

Switches, Float.
Sundh Elec. Co.

Switches, Fuse.
General Electric Co.
Matthews & Bro., Inc., W. N.

Switches, Knife.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
Cutter Co., The.
Electric Controller & Mfg. Co.
General Electric Co.
Jewell Elec. Co.
Metropolitan Eng'g Co.
Trumbull Elec. & Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Worcester Elec. & Mfg. Co.

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Condit Electrical Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches, Pole Top.
Delta-Star Elec. Co.
General Electric Co.
K. P. F. Elec. Co.
Railway & Industrial Eng. Co.

Switches, Remote Control.
Anderson Mfg. Co., A. & J. M.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
Sundh Elec. Co.

Switches, Series.
G & W Elec. Specialty Co.

Switches, Snap and Push Button.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
Trumbull Elec. Mfg. Co.

Switches, Time.
Campbell Electric Co.
Hartford Time Switch Co.
Paragon Electric Co.

Tachometers.
Biddle, James G.
Bristol Co., The.
Esterline Co. The.
Foxboro Co., The.
Keystone Elec'l Inst. Co.
Roller-Smith Co.

Tanks.
Riter-Conley Co.

Taps & Dies.
Carpenter Tap & Die Co., J. M.

Telephone Service.
American Tel. & Tel. Co.

Telephones.
Manhattan Elec'l Supply Co.
Western Elec. Co.

Testing Apparatus.
American Transformer Co.
Biddle, James G.
Esterline Co.
Keystone Electrical Inst. Co.
Leeds & Northrup Co.
Roller-Smith Co.

Testing Laboratories.
Elecl. Testing Laboratories.
Leeds & Northrup Co.

Theatre Dimmers.
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.

Thermometers.
Bristol Co., The.
Foxboro Co., The.
Keystone Electrical Inst. Co.
Leeds & Northrup Co.

Tools, Construction.
Klein & Sons, Mathias.

Tools, Linemen's.
Klein & Sons, Mathias.
Western Elec. Co.

Tools, Portable Elec.
Chicago Pneumatic Tool Co.

Tools, Underground Conduit.
Cope, T. J.

Towers, Transmission.
American Bridge Co.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Blaw Steel Cons. Co.
Coombs, R. D.
Franklin Steel Works.
Riter-Conley Co.
Transmission Eng'g Co.

Transformers.
Adams-Bagnall Elec. Co.
Allis-Chalmers Mfg. Co.
American Transformer Co.
Campbell Electric Co.
Crocker-Wheeler Co.
Duncan Elec. Mfg. Co.
Enterprise Electric Co.
Kuhlman Elec. Co.
Metropolitan Eng'g Co.
Moloney Elec. Co.
Packard Elec. Co.
Pittsburgh Transformer Co.
Triumph Elec. Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Ins. Co.

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General Electric Co.
Pittsburgh Transformer Co.
Westinghouse Elec. & Mfg. Co.

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General Electric Co.
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Jenkins Bros.
Ohio Brass Co.

Valves.
Jenkins Bros.
Ohio Brass Co.
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Valves, Pumps.
Jenkins Bros.

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Builders Iron Foundry.

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Builders Iron Foundry.

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Trump Mfg. Co.

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Lincoln Electric Co.
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Universal Winding Co.

Winding Machinery.
New England Butt Co.

Wire, Copper Clad.
Page Woven Wire Fence Co.

Wire, Molybdenum.
Commercial Research Co.

Wires, Resistance.
Driver-Harris Wire Co.
Electrical Alloy Co.

Wires and Cables.
Acme Wire Co.
Amer. Brass Co.
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Amer. Steel & Wire Co.
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Benedict & Burnham Mfg. Co.
Central Electric Co.
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Independent Lamp & Wire Co.
Indiana Rub. & Ins. Wire Co.
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Lowell Ins. Wire Co.
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Simplex Wire & Cable Co.
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NOTICE TO ADVERTISERS:

Printing begins on Friday preceding week of issue. Changes of Copy for standing advertisements should be received not later than Friday preceding week of issue, but no proofs can be submitted.

New Advertisements (not changes in copy) received on Wednesday can usually appear in the issue of that week.

If Proofs Are Required before printing, changes of copy and copy for new advertisements must be in our hands two weeks in advance of the date of publication. The paper is dated Saturday but is out Friday.

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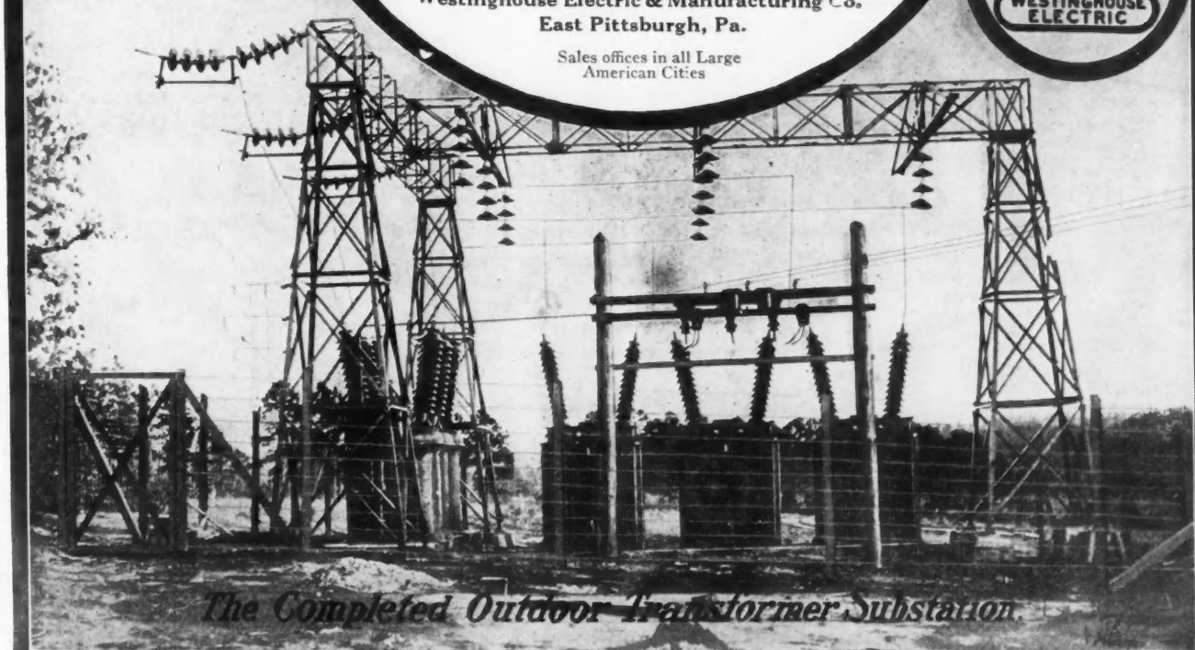

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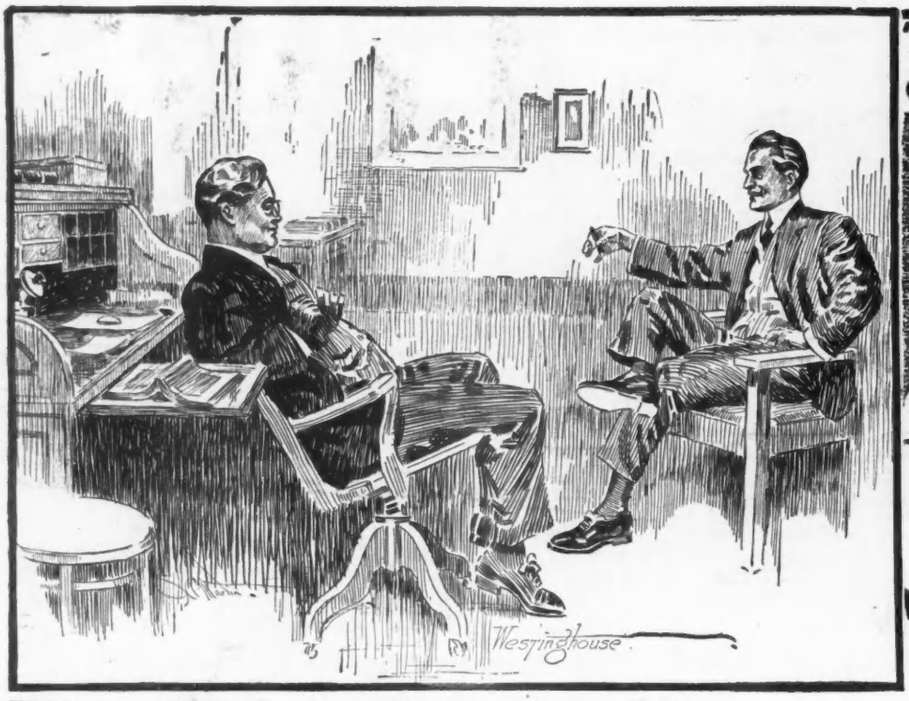

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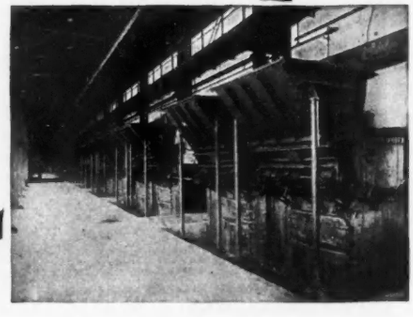

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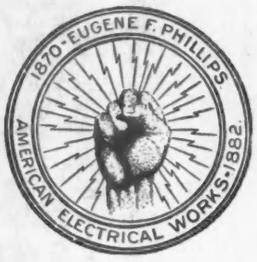

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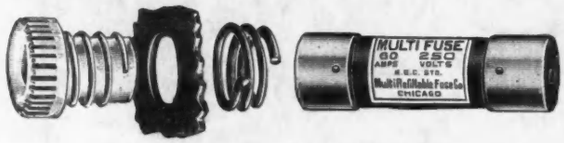

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